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SURGERY

ITS PRINCIPLES AND PRACTICE.

CHAPTER I.

NARRATIVE OF SURGERY; A HISTORICAL SKETCH.

By James Gregory Mumford, M.D.,

BOSTON.

"Ut transeundi spes non sit, magna tamen est dignitas subsequendi."—Quintilian.

HIPPOCRATES.

470 to 361 B. C.

Hercules was the father of Æsculapius, who was the father of Polidarius (one of Homer's heroes), and so on for twelve generations until we come to the first Hippocrates, who was the grandfather of the second Hippocrates, the *Great Hippocrates*, born about 470 B. C. Much of this genealogy is myth, but there is no myth about Hippocrates. He was a man.

Among medical heroes it is the positive, the virile, the real, that appeals to us. Mists and vapors, hypotheses and systems, do not interest the average modern reader; but things accomplished and the final word said, do interest him. So observe this, that deeds done, facts accurately stated, action taken in accordance with what is known,—these things are characteristic of the history of surgery as distinguished from much of the history of medicine. Often we cannot divorce the two tales of medicine and surgery, but very often we can; and when this is possible, the tale of surgery and of the surgeon will attract us.

Hippocrates was the Father of Medicine, but he was a surgeon also; Herophilus after him was a surgeon; so were Asclepiades and Soranus and Galen and Paul of Ægina, and others of whom the writers tell.

Who was this famous Hippocrates? Where did he live? What were his teachings, and who his professional forebears? What was it he did that he is to be remembered as the father of us all?

Hippocrates was born and lived in stirring times. His native place was the Greek island of Cos, close to the coast of Asia Minor, and in about the latitude of Sparta. In those days the tide of Persian invasion was being rolled back; the Athenians, under Cimon, were re-establishing Greek supremacy in the Levant, on the eastern shores of the Ægean

Sea, and Athens was developing that era of social and intellectual greatness to which we now refer as the Age of Pericles—an era covered roughly by the sixty years subsequent to the battle of Salamis (480 B. C.).

Hippocrates grew up in an island Athenian in its sympathies and affiliations; and the influence lasted throughout his life. He came of a family of physicians, long trained in a medical practice handed down from father to son; and be it observed that medical practice was not altogether contemptible even before his time. For more than a thousand years the surgery of Egypt had meant something to the world, and the ancient Egyptian custom of embalming the dead had given its practitioners a little crude knowledge of anatomy. They trephined the skull for migraine and epilepsy, they performed circumcision, they removed superficial tumors, and they set broken bones.

Then there were the Old Testament Jews, who made acquaintance with surgery, an acquaintance acquired from their Egyptian masters. They sutured wounds and passed the uterine sound; they appear to have operated for imperforate anus and are said to have used some feeble anesthetics. There were dentists among them who inserted false teeth, and there were artificers of wooden legs. Such accomplishments show very practical advances in surgery, many centuries before our era.

Egyptian surgeons became famous; they traveled and visited foreign courts and peoples, practising upon the bodies of Arabians, Persians, Assyrians, and Greeks. Nor were the Greeks themselves idle through all those years. In some sort they were the Yankees of that far-away ancient world. They were travelers, traders, seamen, and scholars,—always restless, eager, inquisitive; seeking new markets, planting colonies, looking for knowledge.

It came about, then, long before Hippocrates was born, while Æsculapius was being deified and Polidarius was quoted still, that much of the Egyptian learning was beginning to find its way to the Greek mainland and to the islands of the sea. Surgeons were esteemed in that Greek country of intelligent men, for the people were warlike, and even in the days of Homeric heroes there was honor for those who healed the wounded. A little later one learns of Æsculapian families (Asclepiadæ) settled, and of their establishing medical schools, or systems of healing, in various parts of the Greek world; whether or not they were descendants of Æsculapius matters nothing now; but, mark you, these men were physicians and surgeons, not priests; though priests of the temples of Æsculapius did come to occupy an important place in the thoughts of the people.

So the profession of medicine became hereditary in certain families. The practitioners lived together in little communities, to which patients went for treatment. In these communities schools grew up and records were kept; experience accumulated; knowledge was transmitted from generation to generation. The young men were educated carefully and broadly; they were general practitioners as well as specialists; now and again a promising lad was sent abroad to complete his studies. He went to Athens, to Rhodes, to Cyrene, to Cnidos, to Cos; through Syria, Persia, Egypt. He traveled on foot or by ship; studying the peoples and the

languages, visiting famous men and famous places. He inspected clinics, he followed special forms of treatment; often he tarried long. Such a man might spend years, or a lifetime, even, in acquiring special knowledge or in broadening his general culture. Betimes he was tempted by a handsome offer from some foreign ruler or great man to stay with him and practise. Great surgeons of those days were known to pass their lives in such professional adventures; in settling and studying and practising and moving on, consumed always by a restless craving for new knowledge. There must have been a fascination about it, and in those days when your neighbor-city was a month's journey distant, when language changed with every hamlet, when information traveled at a foot-pace and news was news still for a decade, one may fancy the delight of moving on and on, leisurely learning things and doing things. The knowledge thus gained was brought back to the home schools, in greater or less amount, and those schools became dêpots for the learning of the day. So it is probable that before Hippocrates, a good part of the surgical acquirements of earlier times had been collected in his family school in Cos. The fifty years preceding his birth were active years with men. There had come a sudden rush of expansion among the Greeks to the west; and the Persians to the east were extending their boundaries and rolling forward to the Mediterranean those vast armies and armadas which the Greeks crushed at Platæa, Salamis, and Mycalé. There was extensive experience of military surgery, and the surgeons of Cos doubtless saw their share. Records of such things, fragmentary, unsystematized, but abundant, were accumulating.

It was into this world and to such a life that Hippocrates was born. He was the prophet needed to give articulate expression to that formless learning, to show the meaning of what other men had seen, and out of his own wide experience to add the master-word of the great teacher. Fain would one know more of his life. We glean scattered fragments from the old writers; there are letters and gossip and tradition, but no connected tale. He grew up and studied his profession in Cos; then he set out on his travels. There is an old lie about his reason for leaving home—a lie often refuted; his detractors used to say that he owed a great part of his knowledge to the famous library in Cnidos, a promontory of the mainland about twelve miles south of Cos; that after he had extracted from the library all he could, he burned it down so as to balk all future students; and that then he ran away. At any rate, he traveled in many lands, returning at times to his native place for rest and further teaching. How far his wanderings took him does not appear, but mostly he lived and practised in sundry places on the Greek mainland, as well as in that country latterly called Turkey in Europe; we hear of him in Athens, Delos, Thessaly, and Thrace. During his journeyings he married and had several children. Two sons, Thessalus and Draco, are known to us, and each of them had a son Hippocrates. All were physicians, calling Cos their home. A daughter of our Hippocrates married Polybus, in his turn a celebrated physician. Hippocrates spent many of his best years, youth and age, in Thessaly and Macedonia. Thessaly was his first abiding-

place after he left home, and he became widely known while living at Larissa. They tell a story about him in this period: Perdicas was a young king of the neighboring country of Macedonia. For many months he had been thought to have consumption; at last, taking counsel with wise men, he sent to Larissa for Hippocrates to cure him. That shrewd physician quickly convinced himself that the king was a timid lad, hopelessly in love; "Nor in this was he mistaken," as the chronicler says,* "for Perdicas, after his father Alexander's death, had become passionately enamored with his father's concubine, Phila; who when the matter was communicated to her by Hippocrates, so accommodated her behavior toward the King that his health was in a short time completely restored." The later history of this accommodating lady we know not.

Various scattered anecdotes of Hippocrates and other people are told, and he himself writes of many places. Shortly after prescribing for Perdicas he was urged to go to Abdera, on the southern coast of Thrace, to combat the plague. That distemper was then ravaging the northern shores of the Ægean Sea, and distant peoples were clamoring for Hippocrates. It was the Plague of Athens, described centuries later by a brilliant young American.† The scourge lasted many years, moving slowly up and down the coast, and Hippocrates fought it here and there. Pericles died of it in 429 B. C., when it raged at Athens, and that year or in later years Hippocrates did what little he could for his beloved Athenians. In such scenes and so occupied he passed his long and active life. Artaxerxes in distant Persia heard wonderful tales of the famous Greek, and sent him a great fee to come to his court; but Hippocrates refused to listen. He was growing old then, the devastating Peloponnesian wars were wrecking his Greece, and he seems to have felt that his place was among his own people.

Hippocrates was a contemporary of Socrates, but he was a better practical philosopher. During his life men heaped honors upon him, and after his death they deified him. Even among his own Coans nothing was held too good for him. Indeed, he had helped those brethren of his in many ways which they could appreciate, and they marked him by an initiation in the sacred Eleusinian rites after a manner which no mortal since Hercules had enjoyed. A public entertainment was instituted in honor of him and his posterity.

In his old age, the length of which is disputed, Hippocrates went back to his favorite Thessaly. There he lived until nearly a hundred,—some say he was 109 years old,‡—and there he died in that Larissa whence he had gone to the rescue of love-sick Perdicas more than half a century before.

The Father of Medicine taught the "humoral theory" of disease; that the body contains four humors—blood, phlegm, yellow bile, and black bile, a right proportion or mixing of which constitutes health; improper

* John Moffat, M.D.: "Life of Hippocrates," London, 1788.

† E. H. Smith, in "New York Medical Repository," 1795.

‡ The commonly given dates of Hippocrates are, 460 to 361 B. C.; but there is no certainty.

proportion or irregular distribution constitutes disease. That is a concise statement of the humoral theory, interesting to surgeons even. Most moderns, when they hear of Hippocrates, recall vaguely the humoral theory and the "Hippocratic oath."*

It is needless here to discuss at large his teachings. The "oath" indicates the dignity and honorable aims of the profession for him. Moreover, he was the first clearly to show that the study of disease must be through observation and deduction. With such tools as he could command he made his diagnoses and his prognoses. He and his disciples carried the art of prognosis far. Their conclusions were drawn from symptoms, but their rare patience in studying and recording these gave great value to their forecasts. In a word, that was scientific medicine.

One might devote a chapter to the surgery of Hippocrates.† He discoursed wisely and elaborately of fractures, of joints, of the structure and diseases of bones, of ulcers, of fistulas, and of hemorrhoids. A great deal that he wrote is sound still, though many of his conclusions do not coincide with those of modern experience; however, it is all much more final today than are his purely medical writings. The stamp of truth is on all the genuine Hippocratic work. He reported cases good and bad, and extenuated nothing in the telling. He dwelt also upon the patient's general condition as affected by special lesions; upon fever, delirium, wasting, and the constitutional tendency. He noted especially the breathing, the facial expression, pallor, the body temperature, and the appearance of the urine, feces, and blood. In addition to these elaborate dissertations, his writings deal with trephinings, with the reduction of hernia, with herniotomy, and with lithotomy by both the perineal and the suprapubic routes. He described pneumothorax and opened and

* This famous fragment of old days is still vibrant as many an ancient liturgy: "I swear by Apollo the physician, and Æsculapius, and Health, and Panacea, and all the gods and goddesses, that, according to my ability and judgment, I will keep this Oath and this stipulation—to reckon him who taught me this Art equally dear to me as my parents, to share my substance with him, and relieve his necessities if required; to look upon his offspring on the same footing as my own brothers, and to teach them this Art, if they shall wish to learn it, without fee or stipulation; and that by precept, lecture, and every other mode of instruction, I will impart a knowledge of the Art to my own sons, and those of my teachers, and to disciples bound by a stipulation and oath according to the law of medicine, but to none others. I will follow that system of regimen which, according to my ability and judgment, I consider for the benefit of my patients, and abstain from whatever is deleterious and mischievous. I will give no deadly medicine to anyone if asked, nor suggest any such counsel; and in like manner I will not give to a woman a pessary to produce abortion. With purity and with holiness I will pass my life and practice my Art. I will not cut patients laboring under the stone, but will leave this to be done by men who are practitioners of this work. Into whatever houses I enter, I will go into them for the benefit of the sick, and will abstain from every voluntary act of mischief and corruption; and further, from the seduction of females or males, of freemen and slaves. Whatever in connexion with it, I see or hear, in the life of men, which ought not to be spoken of abroad, I will not divulge, as reckoning that all such should be kept secret. While I continue to keep this Oath unviolated, may it be granted to me to enjoy life and the practice of the Art, respected by all men, in all times! But should I trespass and violate this Oath, may the reverse be my lot!"

† In Francis Adams's two-volume edition of the "Genuine Works of Hippocrates" nearly all of the second volume deals with surgery.

drained the chest for empyema and hydrothorax. All these things and many others he did, and he seems to have done them well. The most interesting feature of his work for us is that he had a clear conception of a great number of surgical lesions, that he described faithfully and graphically what he saw, that he employed rational surgical methods of treatment, and that he taught others what he knew.

All this sound work so appealed to men in that ancient world of limited knowledge, that they came to regard the steward of a few things as the master of many things. Whatever Hippocrates taught was true in their eyes, and in the changes of idealistic philosophy which followed his era, men continued to cling to those facts which Hippocrates had given them.

GALEN.

131 TO 201 A. D.

Nearly five hundred years elapsed between the death of Hippocrates and the birth of Galen—half a millenium; a period equal to that which separates us from the battle of Agincourt and the ancient French surgeon, Guy de Chauliac. Galen revered Hippocrates and followed his teachings and quoted him in his books. Who quotes de Chauliac?

During those five hundred years after Hippocrates the world of politics had moved on, and the map-makers had been at their work. The glory of the Greece of Pericles had departed; Alexander had conquered his world and wept and died; under his lieutenants and successors a Greek Egypt had risen and decayed; Carthage had fallen; the Roman Republic had embraced the world and given place to the Roman Empire; Jerusalem had been destroyed, and Christianity was gathering strength for that sweep of progress which was to increase in proportion as Rome declined.

Surgical science could show no stupendous changes. Plato and Aristotle followed Hippocrates; Plato, the immortal idealist, but without the scientific method, influenced enormously the ancient world of thought; while Aristotle, with a keener appreciation of nature, taught surgeons the value of anatomy and some understanding of the inductive method.

After Hippocrates, our landmark is the Alexandrian School, important more especially because Galen studied there in its declining years. Galen was a Greek. You will observe that most of the famous physicians of the old Roman world were Greeks; the Roman genius failed to appreciate and cultivate medicine. As for Alexandria, its influence on the science of antiquity was enormous. Many teachers and schools arose there, and for nearly a thousand years it was the Mecca of medicine. Herophilus,* the great anatomist, taught there. Do we not recall him still in the torcular Herophili?† He founded a school, as did his rival Erasistratus. These men and their followers made famous that Greek city in Egypt, where most of the old-world surgeons studied and about which many of them wrote; Celsus, among others, at the beginning of our era, a scholar

* A Greek of Chalcedon, born about 300 B. C.

† *Torcular*, "wine press."

and compiler, rather than a practitioner, but often quoted as among the fathers. The one great thing accomplished by the Alexandrians was the study and development of anatomy by dissections. Let us remember them for that one thing if for nothing else, for from the decline of Alexandria to the time of Vesalius—nearly one thousand years—knowledge of anatomy made no advance.

Galen was a product of Alexandria. His is a notable name, and the man was a great man. Certain dyspeptic moderns have felt called upon to sneer at him because he knew less than we know; but let us remember that the second century was not the twentieth century, and that according to his lights Galen did a very great work. None but a great man could have controlled medical thought for nearly sixteen hundred years. He was a surgeon as well as a physician and a philosopher.

Claudius Galen was born in the year 131 A. D. He was an Asiatic Greek and his native town was Pergamus on the Caicus River, in southern Mysia. So he was almost a fellow-countryman of Hippocrates, for Pergamus was on the mainland, 155 miles due north of Cos. Galen was a handsome, vigorous, precocious boy, the son of a high-bred, cultivated, and wealthy father, Nicon, a professional architect, who devoted himself to the education of his promising son. The son passed his life among conspicuous scenes and notable men. He was extraordinarily able, steeped in Greek culture, and intolerant of humbugs and fools; not a comfortable man to live with, if one may judge from his own writings, for he was conceited and short-tempered,—a very different person from the steady, kindly, great-hearted Hippocrates; but his lines were laid in difficult times, and he scorned his superficial, cynical, flabby-minded professional colleagues of Rome, where his most productive years were spent. The history of Galen and his times is intensely interesting. To the twentieth-century reader none of the ancient physicians seems so modern, so vital, so human. His accomplished father destined him for a scientific career and had him carefully educated. He studied in the best schools; he was a pupil of the Stoics, the Academies, the Peripatetics, the Epicureans —and he was a faithful pupil. Though not robust in youth, he was active and well trained; his mind was acute, his memory retentive, his understanding just. Men would call him a genius, had not he succeeded the great master Hippocrates. Among his preceptors Galen mentions eight men—names merely, rescued from oblivion. Writers tell us that he was an accomplished physician at the age of eighteen, and that at twenty-one he had composed some medical works. In these days we accept with caution those tales of precocity. However, such learning and such giving forth seem to have been of the schools and not of experience, for Galen appreciated then, as he appreciated through life, that contact with the patient and with the organs of the body is essential. Then as now, too, the actual difference in knowledge of highly trained men was negligible. Distinction consists in exploiting knowledge and making it available.

At the age of twenty-one Galen lost his father. Then the wandering spirit seized him and he began his travels. The experience was such as

our best cultivated men know today. He went for a time to Smyrna and Corinth for the lectures; then to Alexandria. He had an enormous ambition and a boundless curiosity. He devoured and digested all sorts of information. He worked hard for years over anatomy and physiology; he followed eagerly branches of pure science; he became accomplished in letters and the arts. After a year or more in Alexandria he pushed on, observing, comparing, noting,—through Cilicia, Palestine, Italy, Thrace, Macedon, Crete, Cyprus. He visited Lemnos; he traveled in Syria. Like a proper peripatetic, he went on foot, seeing things and remembering them afterward. Finally, in his twenty-eighth year, he went home to Pergamus and settled down to teach, write, and practise. After four years of such provincial life the magnetism of the capital of the world became too strong for him. Making an excuse of sundry civil disturbances and tumults in Pergamus, he set forth again and went to establish himself in Rome.

From his first going to Rome, through the rest of his life, Galen found little peace. He was a strong, outspoken character, always uncompromising, and he made enemies. The profession in Rome was debased. Science had almost ceased to exist there. Commercialism and quackery ruled; the Oath of Hippocrates was a dead letter. A careful writer recently has described the "Medicine and Doctors" of Juvenal.* Now, Juvenal belonged to the generation of Galen's grandfather, but the times had changed little, and for the worse. We must believe the great satirist, beside whose pictures those of Tolstoy pale, when he says that Rome was a vast den of thieves, that life there was intolerable, that decency was almost unknown, that the decalogue was shattered daily in every household; that the doctors were a parcel of vampires, mean-spirited, dishonored, ignorant,—preying upon their patients as upon each other; poisoners, procurers, extortioners. Indeed, that Rome was a sorry place for an honest man of science.

Galen sems to have thought at first that he could bring some decency out of the mire, some return to the spirit of science, but he came bitterly to comprehend the futility of such a hope. The men on the ground had the ear of the degenerate public, and, except among the more intelligent and the powerful as well as among the virtuous few, he found little favor. Fortunately for him, the intelligent and the powerful were more numerous than were the virtuous few, so that he secured work and eminent patrons. Among such distinguished persons he names Eudemus, a peripatetic philosopher; Sergius, prætor at Rome; Barbarus, uncle to the Emperor Lucius Verus, and Severus, the consul, afterward Emperor.

Galen lived and practised in the midst of such people for five years; then in disgust he went home for a short time to Pergamus, but was soon recalled to Italy by the Emperor, to attend him and to combat the plague. He was then about thirty-five years old, and from that time until the end of his life he worked on in degenerate Italy—a scientist striving not to be a courtier. It is not clear what sort of success he made of these striv-

* Eugene F. Cordell, M.D., in "Medical Library and Historical Journal," vol. 8.

ings. Marcus Aurelius wanted to take him as his personal surgeon to the war in Germany, but Galen escaped that service and remained with the court in Rome. There are sundry tales of his cures—tales told mostly by himself, but he has something to say of his failures also. An American writer* dismisses him casually with the statement, "Perhaps the worst to be said of him is that he assisted in preserving the health of Commodus (son of the Emperor), and the best, that he maintained much the same position in medicine as that occupied by Marcus Aurelius in philosophy." Fanciful as is such a comparison, it is certain that both men impressed themselves upon human thought for centuries: Galen growing dim in recent times—an authority no longer; Marcus Aurelius, the emperor philosopher, looming larger through the years.

So far as Galen's life is known to us, however, and long as that life was, there is little more to say of it. He went on with his working and writing; he continued to cultivate the hatred of his colleagues, and he enjoyed to the end the confidence of powerful friends. The exact date and place of his death are not clear. Probably he died in Rome in the year 201 A. D., when he was nearly seventy years of age. However, the surgical achievements of the man must engage us now, and some attempt to explain what it was he did, and why it is that he remains the second great medical prophet of antiquity.

The fundamental reason for Galen's great and sustained reputation is his constant employment of demonstration and his reliance on rational and intelligible evidence. In a broad sense he was a faithful disciple of Hippocrates, for he followed the great master in practising and teaching the essential importance of the study of vital phenomena. Hippocrates confined himself to bedside investigation. Galen went further; he practised and taught laboratory methods through animal experimentation. He was truly our first great physiologist. Mark some of his writings and their bearing upon surgery as a therapeutic agent, remembering at the same time that surgery and medicine had not then suffered that artificial divorce which so crippled scientific progress in the middle ages, and to no small extent does still cripple it. Galen appreciated, as did those other ancients, that physiology is physiology, that diagnosis is diagnosis, and therapeutics, therapeutics, with surgery a branch of therapeutics.

Perhaps his most famous discovery, and the one for which he is best known, is that of the true function of the arteries. Previously, arteries had been held to contain air, as their name implies. He recognized that arteries in the dead appear to be empty or to contain air, but he demonstrated by the double ligature of an artery on a living animal, and subsequent section of the vessel between the ligatures, that the artery is distended with blood. He observed, too, that arterial blood differs from venous blood, and this phenomenon he ascribed to the entrance of some vital element of the atmosphere through the lungs into the arterial system.

More remarkable still, he asserted a fact which even Harvey fifteen

* David Hunt: "Boston Med. and Surg. Journal," vol. cxxxi, 1898.

centuries later did not observe—that there is a terminal communication between the two sets of vessels, veins and arteries; and he used our present word *anastomosis:* "The arteries and veins anastomose with each other throughout the whole body, and exchange with each other blood and spirits by certain invisible and exceedingly minute passages."*

Galen studied the heart also and described its movements in a fashion not unworthy of Harvey. He wrote: "We can also see the arrangement and action of the fibers of the heart under two conditions, either by examining the organ when just taken out of the animal and still pulsating, or by removing the sternum in the manner which I have described." † And let anatomists note that fourteen hundred years before Botali he described the foramen ovale and the ductus arteriosus. He described them as physiologically associated, and as belonging to the fetal condition.

Of supreme interest to surgeons is the fact that Galen knew and practised the ligature of arteries; though it does not appear that he applied the principles to vessels severed in amputations—a principle the establishment of which immortalized our sixteenth-century Paré. In his treatise on tumors Galen describes aneurisms, true and false, and recommends compression for their cure. He preceded Antyllus, whose famous operation for aneurism is still taught in our schools. Antyllus wrote toward the end of the third century, and our knowledge of him comes to us through the encyclopædic Oribasius, physician to the Emperor Julian (361 to 363). Certain it is, therefore, that the daring operation of double ligature and incision was unknown to many-sided Galen.

The nervous system was Galen's favorite field of investigation. He regarded the brain as the central organ from which the spinal cord is an offshoot, and recognized that the nerves are structures designed to convey impressions of sensation and motion. He taught that "the muscle is the instrument of voluntary motion; and we have seen whence the principle of this motion originates, and by what path it travels. It comes *from* the brain and *through* the nerves."

The functions of the cord, too, received his elaborate consideration, and to all of his statements he brought experimentation for proof.‡

He advocated, accordingly, sundry operations for injuries to the brain and cord, and he advocated them intelligently. Others among the ancients were familiar with such procedures, but much of Galen's writing has a curiously modern sound. He used the trephine on the head less than did others of his time, for he preferred the gouge and chisel. In injuries to the spine with compression of the cord he appreciated the condition, made a proper diagnosis, and advised an operation for relief.

Briefly recorded, such are some of the achievements of this remarkable man. Doubtless many of his views were erroneous and his advice unsound. He was a voluminous writer, who felt that his mission was to

* "De Usu Partium," vii, 19.

† Ibid., vi, 8.

‡ Vide "De Hippocratis et Platonis Placitis," vii, 8; "De Administrationibus Anatomicis," vii, 9, 10; "De Locis Affectis," iii, 14.

instruct the profession in every branch of medicine. Often he was visionary; often, for lack of the microscope and of a knowledge of chemistry, his assertions were mere guesswork and his hypotheses untenable; but, with such light as he had, his methods and purposes were correct. If he had lived in more settled times and among a people sensible of the meaning of science as he taught it, there can be no doubt that the impetus he gave to medicine would have broadened into great schools of learning such as the world had to wait for during nearly eighteen centuries. With his death and the passing of his immediate successors progress languished and expired, for the ancient world was dying and was bearing down with it the humaner arts.

The significance of all this belongs to the domain of world-history rather than to this simple narrative; but the course of world-history bears immediately upon our theme. That corrupt, besotted, old civilization must needs have been destroyed. The rough, wild, clean-bodied barbarians had to be turned loose for centuries over the earth to sweep it clean, else had mankind expired of very rottenness. For generations it seemed that the Church alone had survived—that wonderful Church, adored, feared, reviled, misjudged, and misjudging. Now a sink of superstition and cruelty and folly; again the staunch, unterrified, unbroken guardian of shattered civilization; cherishing, ignorantly often, but jealously and fiercely, the records of a past science. It is the fashion of writers bitterly to accuse the Church of standing doggedly across the path of knowledge and persecuting the disciples of truth; and doubtless the charge is a thousand times just, but we must remember also that what little western learning survived through the dark ages was stored and guarded in monastic vaults and clerical libraries—wealth unrevealed and unknown even to the custodians, but still in some fashion preserved for the enlightenment of wiser generations.

Briefly, then, what have we seen to be the course of medical science? Among the Greeks medicine held a high place, for the Greek genius was most conspicuous in the affairs of civil life and the realm of intellect. Among the Romans, military affairs were regarded as most worthy the attention, and this worship of physical force stunted eventually intellectual growth and pursuits. After the republic, the rise of a military aristocracy accentuated still more this tendency, and made permanent the inferior position of the learned professions, especially of medicine. During nearly two thousand years this Roman influence maintained, for even after the rise to power of the Church of Rome the soldier continued to be regarded as the superior of the priest. First the soldier; second the priest; third the lawyer; fourth the merchant; fifth the physician, and then after a long interval the surgeon, ranking with the humblest of craftsmen.

VESALIUS.

1514 TO 1563.

Andreas Vesalius was born on the last day of December, 1514—nearly thirteen hundred and fourteen years after the death of Galen. Imagination is staggered by the attempt to grasp in detail that mighty span of centuries; yet the meanest imagination among us could measure with a foot-rule the intervening progress in science. Galen's works were text-books still. Names are named in the interval, and a few good surgical writers,—Antyllus and Oribasius already noted, Ætius Amidenus, Alexander of Tralles, Paul of Ægina,—all belonging to the old order. Then there were the Arabians, Avicenna (980–1037 A. D.) and Albucasis (died about 1105 A. D.).

Those Arabians are worth noting as we pass. Medical science must generally be looked for at its best among forward and active peoples, and during the middle ages the Arabs were conspicuous in the world's history. Both Avicenna and Albucasis were authorities for centuries,—not so much for any new thing they did as for their compiling and bringing before the medical public, such as it was, the best ancient teaching, otherwise lost or forgotten. In a way they were necessary to Vesalius.

Vesalius is a landmark in our course because he did new and important things. He cast aside tradition and saw with his own eyes. Men say that he overthrew Galen; but in truth he was the follower of Galen in science—the first man known to me, for thirteen centuries, to adopt and practise the methods of that ancient master. He improved on Galen, he corrected many of Galen's errors, he came to be a man full of novel lore; but why disparage Galen? Do not we twentieth-century students know things undreamed of by Hunter, Rush, or Drake? Vesalius is not generally reckoned among the surgeons; indeed, surgical writers pass him by and tell rather of his contemporary, Ambroise Paré, of whom we shall hear; but to-day Vesalius would properly be regarded as a surgeon. He held a chair of surgery; he was a profound student, the founder of modern anatomic research, the man who made possible for us a development of surgical science.

Fain would one dwell upon those wonderful years of the sixteenth century, when Vesalius lived and taught. We are wont to sum it all up in the word Renaissance. That was the springtime of our world. Great names crowd the text—Luther, Michælangelo, Raphael, Titian, Copernicus, Columbus, to go no farther. Men were breaking away from tradition, the dark veil of the middle ages had been rent. In the midst of such stirrings Constantinople fell before the militant Turk, and wise men fled from the ancient capital, bearing with them, for their western brethren, forgotten treasures of Greek literature and science.

The story of Vesalius's life is far different from that of the rude craftsmen who composed the surgical guild of his day. He was a cultivated product of the great universities, with learning as well as genius, and he came to appreciate early the importance of anatomy and its bearing upon surgery.* He was born in Brussels of an excellent burgher family,

* "Vesalius: His Forerunners and Followers," Lecture I, in "The History of Physiology," by Sir Michael Foster, 1901.

established for generations at Nymwegen. His traditions were of the best, for he came from a line of physicians and learned men. His father was apothecary to Charles V. Like Hippocrates and Galen, Vesalius was carefully educated, and spent many of his youthful years at the famous old University of Louvain, not far from home. Alas, for our lack of space! that old university life is a subject worthy of study.

The lad was born with a passion for dissecting. At Louvain he had to be satisfied with animals. Then, at eighteen, in 1533, he went to Paris

FIG. 1.—ANDREAS VESALIUS.

to learn of Sylvius (Du Bois)—that Jacobus Sylvius after whom the fissure is named.

Sylvius was no surgeon, he was not even a great anatomist. He was a lecturer who read out of Galen to his pupils sitting about, with an occasional dead body before them. Now and then, by direction of the master, the crude barber assistants exposed roughly some structures for the gaze of the audience.

This was futile work. Stories are told of Vesalius's impatience; one of them that at the third demonstration, exasperated by the ignorance

displayed, he thrust aside the stupid assistants and showed with his own hand how the dissection should be done. That anecdote is the key to the man's life. Anatomic research, applied anatomy, physiologic deductions from such tasks, surgery, and general practice were to be his work, but always he turned back with almost fierce joy to anatomy and surgery. He spent three years of study in Paris; then another year in Louvain, where he issued his first publication,—a translation of the ninth book of the Persian, Rhazes,—and then he went to Italy, where his masterpiece was to be accomplished. It is interesting to note that while a lad in Venice he probably knew the young monk Ignatius Loyola, founder of the Order of Jesus.

The abilities of Vesalius must have been brilliant and conspicuous, for almost at once he attracted the attention of leading men in Venice. He was granted the M. D. of Padua in the same year, 1537, and soon afterward, when but twenty-two years old, was given the chair of Surgery and Anatomy in that University.

Opportunity for anatomic study was greater then in Padua than anywhere else in Europe. The authorities were nursing the University and the restraining hands of the Church were held off. For five years Vesalius worked there with enormous success. He was instantly popular as a teacher; he was an inspiration to thousands of students. He told them what he knew, and, most important of all, he taught them the scientific method. He killed and buried the old system of authority in anatomy. Though the edifice of speculative medicine survived for many years, he weakened its foundations.

In 1543, the sixth year of Vesalius's life at Padua, he published the "Fabrica Humani Corporis." Promptly the heavens were opened, and the wrath of entrenched conservatism descended upon him. Just before his book appeared he had left Padua for a time, with the consent of the Senate, and it was during this absence that the storm raged. His old master Sylvius and others thundered against him for daring to point out that Galen was wrong. He returned to Padua after a year, but found that even there opposition to him was strong. He gave a few lectures in Padua, Bologna, and Pisa, demonstrating again on the cadaver the truth of those things he had published, but at last, wearied of persecution and contemptuous of his weak-kneed world, he gave up his career and accepted the post of court physician to Charles V.

There is little more to tell. Vesalius continued in the service of his patron. Twelve years later, on the abdication of the Emperor, he was transferred to Philip II. He chafed against the life; now and again he attempted to break away. Then in 1563 he started out on a pilgrimage to Jerusalem. He visited Venice. He renewed former friendships. We can believe that he may have intended on his return from the East to continue the pursuit of science as of old; but fate overtook him. He did not live to see his Padua again; he was taken ill on the voyage home, was landed on the island of Zante, and there died in his fiftieth year.

AMBROISE PARÉ.

1510 TO 1590.

We hear a deal of talk about "barber-surgeons" and "surgeons of the long robe"—to our confusion often. Ambroise Paré was a surgeon of both sorts. Let us get clearly in mind the distinction; learn something about the status of surgery in those centuries, and then hear something of the life of that famous man.

We know how in Paré's time the Church had controlled all European

FIG. 2.—AMBROISE PARÉ.

learning for years, save for what the Arabians taught to a few daring and ambitious travelers. In the days of the fathers and in the middle ages, healing was one of the priest's functions. But the shedding of blood was abhorrent to holy men, so they dealt with internal medicine only—in feeble and superstitious fashion, though they had some skill in the treatment of wounds. In such tasks good women, too, had their share; but surgery—the actual shedding of blood—was left to the Jews and to the profane and vulgar. Now, in the dark ages it came about that tonsures

necessitated the presence of barbers in the monastaries; besides the tonsure, regular bleedings were prescribed for certain orders. The much-quoted Gardner* tells us that both duties—shaving the heads and bleeding—fell naturally to the same officer, and there we see the origin of barber-surgeons.

This combination of functions flourished in France. The common barber there was a despicable creature, and the barber-surgeon, too, was contemptible. In Italy, with its greater enlightenment and higher standards of education, the same odium did not attach to the barber-surgeon's office. French customs ruled in northern Europe, however, and the surgeons of England and Germany ranked with their Gallic brethren. So let us observe the situation as it developed in Paré's France.

Long before his time there had grown up a class of regular *physicians*—men educated in a fashion, compelled to know and speak Latin, licensed to practise. They were the great men of the profession, the men at the top, as the barber-surgeons were the men at the bottom. Between the top and the bottom was a third body of practitioners, surgeons proper, who came to be known in France as the confraternity of Saint Cosmo or St. Côme. These were the "surgeons of the long robe," while the barber-surgeons were "surgeons of the short robe." The three sets of men—physicians, surgeons, barber-surgeons—were for long in conflict, as was inevitable. The short robes poached on the preserves of the long robes; that is to say, they went out of their sphere as bleeders and minor operators, and undertook serious major operations. The long robes, who were better educated men, presumably learned in the great writers, and speaking Latin, attempted constantly, by prescription and legal means, to put down these upstarts. At the same time the long robes offended the physicians by prescribing drugs and undertaking general practice. So the long robes were at feud with the men above them and with the men below them.

We need not follow in detail their endless wrangles. Until modern times the physicians maintained their position of superior equipment and authority, but there was constantly a gradual leveling up of the two inferior orders, until in the eighteenth century a broader and more scientific basis for surgery was established. Finally in Paris the confraternity of Saint Cosmo gave way to the Academy of Surgery in 1731, with the great Petit as director, and still later there was added to this the École Pratique de Chirurgie, with Chopart and Desault among its professors.

Ambroise Paré began life as a humble barber-surgeon, and ended as the greatest surgical authority in Europe, and the best beloved man in France. He was not trained in the schools; he was not a great scientist, as was Vesalius. He was a practical clinician, who went through the world with his eyes open, and brought to bear upon his task hard

* John Gardner: "Sketch of the Early History of the Medical Profession in Edinburgh." Edin., 1864.

common sense, impatience of vapid tradition, and an enormous experience.

Paré was born in 1510 in the village of Bourg-Hersent, now part of Laval, in Maine. His father was a servant, possibly a valet and barber; his brother Jehan and his brother-in-law, Gaspard Martin, were barber-surgeons. We have a great deal of light on the training and career of Paré. The student of those times may read the volumes of Malgaigne or the "Life" by Paget. Paré was apprenticed early to a barber-surgeon, and then, in 1533, at the age of twenty-three, he went to Paris, where the plague was raging and work was to be done. Louis XII had died in 1515, and Francis I was king. Paré was destined to see Henry II, Francis II, Charles IX, Henry III, and Henry IV.

Almost at once the young surgeon was appointed a resident in the Hôtel Dieu, that famous hospital then already nine hundred years old, and there he served as pupil, dresser, and operator for three years. Vesalius, who was four years Paré's junior, had just left the place, but they served the same masters and heard the same lectures, for Sylvius taught them both. They were to meet at last after many years—for there is reason to believe they consulted over the death-bed of Henry II in 1559.

Paré's three years of service in the hospital laid the foundation for his remarkable and romantic career.* On leaving the Hôtel Dieu in 1537 he does not appear to have taken with him any special license save his acknowledged ability and a sanguine enthusiasm. He craved more experience and he looked for a permanent abiding-place. So he went to the war in Piedmont, but first made an establishment in Paris. In that way, as Paget says, the two streams of his life flowed on side by side for many years. He was with the army in time of war, he practised in Paris during the intervals of peace.

When Paré was old there was a man living in Paris to whom we owe a great deal. He was one Etienne Gourmelen, Dean of the Faculty of Medicine, and he was a wrong-headed person. In 1580 he published a book, and in his book he attacked Paré. This drew from Paré his famous "Journeys in Diverse Places" (1537–1569), without which our surgical literature would be the poorer. The "Journeys" tells the surgical history of Paré's life, and the wretched Gourmelen is flayed incidentally.

You must take for granted the charm of Paré's tale. A brief outline of it is this, that in 1537 he went off to the wars as an independent surgeon with one Colonel Montejan. In those days there was no organized army medical service. Paré picked up his work and experiences where and as he could. He attached himself to one great man or another for many years, until in 1552 the king appointed him one of his surgeons-in-ordinary. In 1541, when thirty-one years old, he had qualified as a master barber-surgeon.

There was no regular salary for such services as Paré gave, but fees were manifold and often eccentric. We read that at one time he received

* For a delightful account of "Ambroise Paré and His Times" I refer the reader to Stephen Paget's book. G. P. Putnam's Sons, 1899.

a cask of wine, at other times fifty double ducats and a horse, a diamond, a collection of crowns and half-crowns from the ranks, other "honorable presents and of great value"; from the king himself, three hundred crowns; another diamond, this time from the finger of a duchess; and a soldier once offered to him a bag of gold.

Men showered gifts upon him and the army always loved him. His presence alone came to be regarded as equivalent to ten thousand reinforcements. He was the intimate friend of generals and the idol of their troops. He was sane, humane, resourceful; abounding in common sense, in shrewdness, in natural ability. He weighed and winnowed authority; he dared to have original opinions. He loved the people, but he did not hate their rulers; he was loyal, quiet, conservative; Paget says that "he was a man who heartily disliked change, self-will, scepticism, controversy, politics and foreigners." Paré's personality counted greatly. It was so with him as with Boerhaave, and Charles Lamb, and other great ones we know; but he did things, too, for which we must remember him. He made important discoveries and he wrote about them. His publications number eleven and treat of an enormous variety of subjects, professional and extra-professional.

Paré dealt rationally with gunshot wounds, showing that they are not necessarily poisoned and that cleanliness and support often suffice for their cure. He wrote elaborate treatises on anatomy and surgery; a special monograph on head-injuries, and on the plague, smallpox, measles, and leprosy. These were some of his strictly professional writings, and then there was that account of army adventures and military surgery in his "Journeys." He was an eager and vigorous writer, with the story-teller's instinct and a sure sense of proportion. He makes his points firmly and boldly, leaving one ready to hear more. He was as original in his writing as in his practice. He was the first of our great modern clinical surgeons, just as Vesalius was the first of our modern scientists. He made careful and exhaustive diagnoses, he spared the knife so far as possible, he was dextrous and nimble but never slovenly. He was especially skilled in the dressing of wounds, and prided himself on making his patients comfortable. His bandaging was a work of art, for he insisted that the rollers should be neatly and accurately made, and he applied them himself smoothly and deftly.

Paré is known to most of us for two great improvements in our art—a simple treatment for wounds and the use of the ligature in amputations. Space does not permit me to elaborate these two matters; suffice it that he came upon a let-alone treatment of wounds, at Turin, in his first campaign. Old custom prescribed that wounds, and gunshot wounds especially, should be treated with boiling oil—an agony to the patient and the cause of delayed healing. At first Paré used this method fearfully, but after one severe engagement his oil gave out, and he had to content himself with an extemporized simple ointment. To his surprise and joy he found the next day that his patients thus treated had fared better than the others. Former men had seen the same thing, but he had the

genius to take to heart what he saw, and ever afterward, against bitter opposition, he taught the humane treatment.

Paré's use of the ligature for arteries instead of the old cautery came about in a somewhat similar fashion. In 1552 he was with the army besieging Danvilliers: "There was a culverin-shot passed through the tent of M. de Rohan, which hit a gentleman's leg, which was of his household. I had to finish the cutting off of it, which I did without applying the hot irons." He used the ligature and was delighted with the result of his experiment. We know how Galen had ligatured vessels wounded in continuity, but it is to Paré that we owe the end ligature in amputation stumps. Such teaching was revolutionary; it brought upon him the wrath of conservatives, and to the outpouring of such wrath by the foolish Gourmelen we owe such tales as that of M. de Rohan's unfortunate gentleman.

Paré's life was adventurous and brilliantly useful to the last. He was always in the public eye; he saw constant service. In the field it is a story of battle, murder, and sudden death; in Paris it is a record of plague, pestilence, and famine. The end came in December, 1590, when he was eighty years old. He had escaped the St. Bartholomew massacre, he had lived through the wars of the Huguenots, and he died the year of the battle of Ivry, of the siege of Paris, and the final triumph of the house of Bourbon.

ALBRECHT VON HALLER.

1708 TO 1777.

Ambroise Paré wrote in his dedication to the king, of his edition of 1575: "God is my witness, and men are not ignorant of it, that I have labored more than forty years to throw light on the art of surgery and bring it to perfection. And in this labor I have striven so hard to attain my end, that the ancients have naught wherein to excel us, save the discovery of first principles; and posterity will not be able to surpass us (be it said without malice of offence) save by some additions, such as are easily made to things already discovered."

Now, this amazing statement proved fairly sound. In the *art* of surgery after Paré there was no great or radical progress for many generations; indeed, the art of Paré would not have been unworthy the art of Wiseman, of Petit, of Sabatier, of Hunter, or of Cooper even, for not until two hundred and fifty-six years after Paré's death was anesthesia made certain to a waiting world; anesthesia, to be followed by asepsis and the art of modern surgery.

But between Paré and Lister the *science* of surgery did not stand still, for the science of surgery is but one expression of the noble science of medicine.

During those vital centuries anatomy was revised, histology and chemistry were born, and physiology was reborn; the great science of pathology itself came to be intelligently studied; embryology was de-

veloped, and the uses of the microscope were made known, in a limited way, to laborers in all these fields. If this were a history of medical science as a whole, volumes might be written on what was doing during those centuries, but our task is to note merely some of the benefits which that developing science brought to surgery, and to name a few names. The work of Borelli, Malpighi, Paracelsus, Van Helmont, and Harvey concerns us. Borelli was a physicist and physiologist, who worked out the uses of the muscles. Malpighi, one of the greatest of physicians, demonstrated the anatomy of the liver, the kidney, the lungs, the nerves, and the skin. He saw the red blood-corpuscles and he discovered the capillary circulation. Paracelsus burned Galen, threw away traditional therapeutics, and pointed the road to modern chemistry. Van Helmont elaborated the crude teachings of Paracelsus, while the great Harvey, surgeon as well as physician, capped the work of the Continental investigators by his demonstration of the proper functions of the heart and of the circulation of the blood. In such breathless fashion we must brush past great names and events until we come to another milestone on our road—Haller, of Bern and Göttingen. He was a professor of surgery and a physiologist, a teacher rather than a practitioner, but surgeons properly may claim him as their own. As Foster says:* "When we turn from any of the preceding writers on physiology and open the pages of Haller's 'Elementa' we feel that we have passed into modern times."

Albrecht von Haller was born at Bern of a good Swiss family on October 16, 1708; and having done sundry notable things in various parts of the world, he died in Bern in 1777.

It was a marvelous mind, colossal, wide-grasping, omnivorous, retentive, belonging to a domain wider than surgery; but surgical problems occupied some portion of the man's life.

A word about his life: As a child he was sickly and precocious. He mastered strange tongues and was little regarded by his seniors. When less than ten years old he wrote a Chaldee grammar, a Greek and Hebrew vocabulary, Latin verses, and numerous biographies. While still a youth he wrote translations of Horace, Ovid, and Virgil, and an epic poem of 4000 lines on the origin of the Swiss Confederation. He was no prig, and people seem to have loved him even when they could not understand him. But he was little given to sports, and the young men, his comrades, saw in him a paragon rather than a playmate.

When thirteen years old Haller lost his father, and then for a time he went to Bienne, where he studied science and philosophy. After two years there he went to Tübingen for a year, and then at the age of seventeen to Leyden, where he began his formal medical studies. Albinus the younger was teaching anatomy there in that year of 1725, and Boerhaave was drawing from all parts of Europe and from America those great classes which have helped to render him immortal. Immortal he is in some fashion, and in spite of sneers. He was a tireless collector and an inspiring teacher, and in such teaching Haller found his opportunity.

* "History of Physiology," page 207, by Sir Michael Foster.

At eighteen Haller finished with distinction the prescribed course of medical studies, and passed the following year as a graduate student in London, Paris, and Basle; of such wanderings and studies there is no time to speak, but they were fruitful even to the youth not yet twenty. The chroniclers tell next of his return to Bern to become a practising physician. There he worked for six years. He was not a success as a practitioner. The people of Bern were not used to that style of man and shrank from calling him in. But he studied. Ye gods, how he studied! He seems to have devoured the whole known range of medical authors.

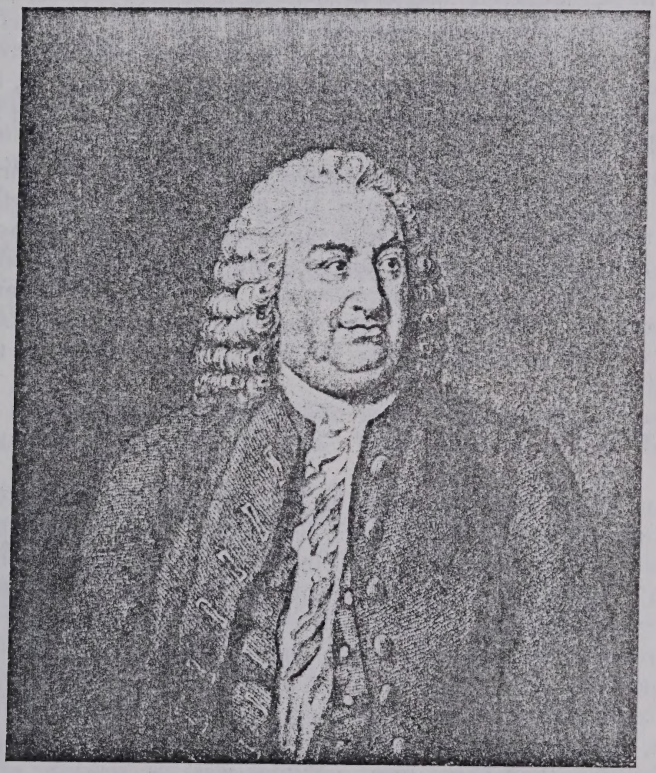

FIG. 3.—ALBRECHT VON HALLER.

He read day and night—at his meals, at the bedside, on foot and on horseback, in his travels and at home. He read, and he remembered what he read. He investigated, too. He explored those wonderful mountains among which he was born, and he came to know his Switzerland as no other man has known it. Besides medicine, he devoted himself to botany, and produced a great work on the Alpine flora. He was a poet.

Still he was without honor in his beloved fatherland. But other people honored him. The scientific world was looking toward him, was reading his books on anatomy, physiology, and botany, and his poems too. In those years men were establishing a new University at Göttingen,

in the domain of that sturdy George II who ruled England also; and casting about for professors in 1736 they called to them the young doctor of Bern. Haller went gladly, because he hungered for peace and for escape from Philistia. He went to Göttingen, to the chair of Medicine, Anatomy, Surgery, and Botany—to a mighty task. For seventeen years in Göttingen his labors were unceasing. He executed faithfully the enormous duties of his office, he stimulated students as none but Boerhaave had stimulated them for centuries. Against modern teachers of science the reproach has been made that they are professional teachers and amateur scientists. One could bring no such reproach against Haller. He knew most things that had been written of ancient science, and winnowed the chaff. But, more than almost any other man who has shared our labors, he possessed that rare type of mind which adds to knowledge. He told men what he had discovered. He excelled as student, investigator, teacher; and during those years the University became famous through all lands.

He went to Göttingen at twenty-eight and he left it at forty-five. Scientists deplored his leaving, and the great ones of the earth tried vainly to hold him back. He had been ennobled and courted by kings, and had sat in the seats of the mighty; but his was a homespun soul, quickly wearied by names and dignitaries. He threw over all, even the beloved society of scholars, and went back once more to his Switzerland. There he persisted in mighty works for twenty years—almost to the day of his death.

Of what sort, then, were those works? How does he touch us surgeons, and why do we claim him? Let a few halting words suffice as answer.

Most important of all, perhaps, he lectured on surgery for seventeen years. Two generations of students heard him. Fain would one have known that privilege. And he published two volumes, "Bibliotheca Chirurgica" (Bern, 1774–75)—a great work dealing with the literature and history of surgery. Its like is to be found nowhere else. So he grouped together the accomplishments of the past and made them available for modern men. Those volumes alone rank him among the most valuable contributors to surgical science, and that though he was no craftsman, and never operated, so far as we can learn. More important for us, however, than those great volumes was his teaching surgeons how to study, and his raising the profession from the degraded place in which popular opinion was holding it. In much of that he resembled and anticipated John Hunter. Haller grasped the wide significance of surgery and showed that it was far more than a mere craft. He brought to bear upon it a profound knowledge of anatomy, a keen-eyed devotion to physiology, and an enthusiasm for pathologic anatomy. He showed the absurdity of the medieval custom which had divorced surgery from medicine and a liberal education, depriving it of the services of distinguished men and cultivated minds. By his example he did more even than by his preaching; he became a great experimental physiologist; through such endeavors he made possible the practical investigation of natural

processes, and through such investigations it has come about that numberless procedures of today are feasible and life-saving. His researches on the mechanics of respiration were striking and important; he studied and explained the formation of bone and he developed the science of embryology. Most important of all, perhaps, he established the doctrine of muscular irritability. Says Foster: "Conspicuous is the absence from his writings of loose expressions and ill-defined general views such as abound in so many of his predecessors. We may take any part of his great work as a trustworthy account of the knowledge of the time with regard to the questions therein treated."*

The problems of digestion also received his attention, and the modern surgeon who operates upon the bile-passages, the stomach, the pancreas, and the intestines may read with profit and pleasure what Haller has to say regarding the functions of those organs. He lived before the development of organic chemistry, but in treating of the pancreas he says: "A part, at least, of the usefulness of the pancreatic juice will be to dilute and soften the cystic juice * * * so that this mixes better with the food. Whence you may explain the hunger of the animals from which the pancreas has been removed, attributing it to the reflux of a slacker bile into the stomach"; and he ends: "There may be other functions of the liquid not as yet well known to us," prophetic of the work of Claude Bernard, a hundred years later.

We need not consider here Haller's elaborate work on the central nervous system, his almost modern conception of the functions of the brain and the purposes and uses of the nerves. Much of it was blind work, groping work if you choose, for he had to build up his hypotheses from experiments made with difficulty and often ineffectively, lacking our elaborate laboratories and our instruments of precision. We have indeed gone forward in a thousand ways, but we must look back to Haller as one of the greatest of the fathers, and admit that recent progress is due to the fact of our having worked upon his lines.

Such in broken outline is a sketch of Haller's great labors, and in such labors he continued nearly to the end of his life. In youth and early manhood at Göttingen he studied and taught and stored, giving forth here and there as special interests and occasion offered. In his maturity at Bern he produced his important writings, and the impulse of those writings is still upon us.

There was invalidism in his life. It was a mighty soul in a feeble body. He suffered much. In old age he was forced to the use of opium, and he died with finger on pulse; his last words, "The artery no longer beats."

* Ibid., page 207.

JOHN HUNTER.

1728 TO 1793.

"Up from Earth's Center through the Seventh Gate
I rose, and on the Throne of Saturn sate,
And many a Knot unravel'd by the Road;
But not the Master knot of Human Fate."

In Scotland have appeared two men—Hunter and Lister;—great men in the history of surgery. Hunter dominates the eighteenth century, Lister is conspicuous in the nineteenth,—a man whose fame is destined to grow with the lapse of years. Hunter was greater than Haller in his influence on the practice of surgery, though the balancing of great men against each other is profitless. Hunter, Haller, Morgagni, are the famous names for us in the eighteenth century—Morgagni, pathologist; Haller, physiologist; Hunter, pathologist, physiologist, surgeon. It was time for Hunter. Since Vesalius and Paré, experience had been accumulating, research had been extended, books had been written, and knowledge had been diffused. Many able surgeons also had lived in this interval: Hildanus (1560 to 1624), the "Father of German surgery," a title properly belonging to Heister; John Schultes or "Scultetus" (1595 to 1645); Matthæus Gottfried Purmann (1649 to 1711?), a celebrated German; the Englishman, Richard Wiseman (1622 to 1676); known as the English Paré; Alexis Littré (1658 to 1726), who proposed inguinal colostomy in 1710; Jean Louis Petit (1674 to 1750), the great French teacher and reformer; Henri François le Dran (1685 to 1773), Claude Nicolas le Cat (1700 to 1786), the lithotomist of Rouen; Dominique Anel (1678 to 1725?), of aneurism fame; Jean Louis Belloq (1730 to 1807), who invented the nasal canula. Among the contemporaries and seniors of Hunter were Pierre Joseph Desault (1744 to 1795); François Chopart (1743 to 1795); Raphael Bienvenu Sabatier (1732 to 1811); William Cheselden (1688 to 1752); Percival Pott (1713 to 1788). Such are a few of the striking names in the surgical literature of the period. All of those men were able, active, and highly intelligent practitioners. Most of them were popular teachers and reformers; they devised new instruments and procedures, they perfected old measures, they adopted and utilized new discoveries, they raised the standard of education, and they abolished the barber-surgeon. But there was no prophet among them. Haller, indeed, was a marvelous investigator and teacher, but he was not a practical surgeon, and his discoveries came slowly to fruitage. John Hunter was the man for whom the profession waited.

Not long ago a well-known teacher, in addressing an audience of physicians, said: "Surgeons in the past have devoted themselves to the studies of anatomy, pathology, bacteriology, but they have neglected physiology. It is to the teachings of physiology that the surgeons of the future must turn for advancement in their art." He forgot John Hunter. An English writer has told us that to Hunter's sound teaching of anatomy, comparative anatomy, and pathology, and to the methods he employed and demonstrated to Jenner, Cline, Cooper, Abernethy, Home, Physick and a host of others, the great nineteenth-century school of English surgery

owes its fame. All that is true, but Hunter did more than that. He was a great philosopher in the broad sense, as well as a student of the natural sciences. To this day his genius dominates and inspires our science. For nearly one hundred years the Hunterian Oration, instituted in 1813 by Baillie and Everard Home, has perpetuated the work and teachings of this man, and has drawn lessons from his career. So our

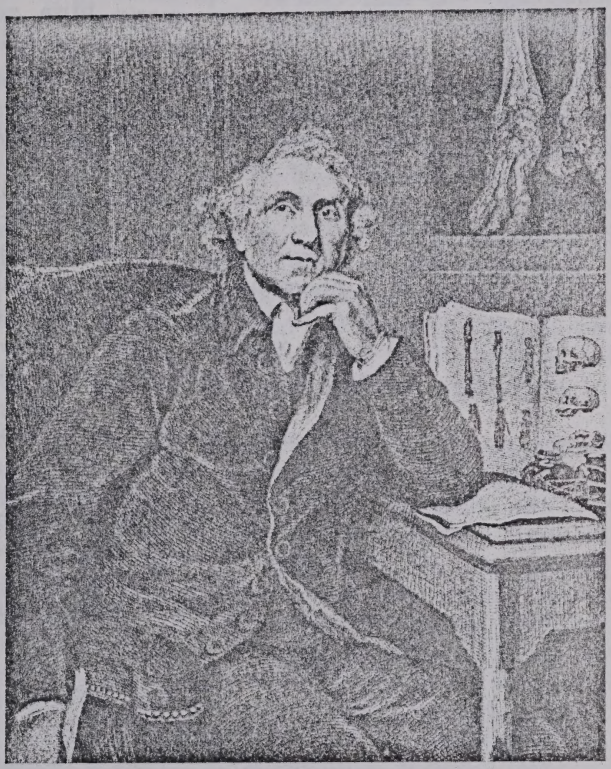

FIG. 4.—JOHN HUNTER.

materials for a study are abundant, and our accumulated knowledge of him is great.*

John Hunter was a Scotchman, of good, robust, middle-class stock. He owed a good deal to his ancestry probably; certainly many of his immediate relatives distinguished themselves and showed the advantage of a clean and vigorous heredity.† Hunter's father is described as a small

* The best "Life" is that recent one by Stephen Paget. In 1841 Drewry Ottley wrote a dreary account of John Hunter, prefixed to Hunter's Complete Works, edited by J. F. Palmer. Everard Home wrote a fragmentary and unreadable sketch of him for the first edition of the "Treatise on the Blood and Inflammation," 1794; and numerous writers, Sir C. Bell, Professor Owen, John White, and many authors of Hunterian orations, have dealt with phases of Hunter's life and work.

† Of his famous elder brother William we shall hear. His brother James, who died young, was a promising anatomist; his sister Dorothea was the mother of Dr. Baillie, the clinician, and of Joanna Baillie, the authoress.

farmer living on his own estate, Long Calderwood, in the parish of Kilbride East, Lanarkshire, and there John Hunter was born on the 14th of February, 1728, as he himself always stated.* He was the youngest of ten, five sons and five daughters. James was the eldest of the family; William, the fourth son, was ten years senior to John.

It is always interesting to learn something of a great man's formative years, but of John Hunter's youth we know little. He seems to have been a vigorous, out-of-doors lad, devoted to rural sports, little given to books, but neither indolent nor unobservant. Indeed, how could he have been either? The tireless student and keen observer of the fifties could not well have come out of a dull and obtuse rustic of the forties. They say his mother petted him, which is true, doubtless, for was he not the youngest of ten? And at seventeen he was sent to Glasgow to help straighten out the affairs of a good-for-nothing brother-in-law—a bootless errand; but fools are not sent on such errands save by the Dr. Primroses of this world. There is no doubt, however, that Hunter received scant schooling, and that in his young manhood he was ignorant of books; but he was vigorous and ambitious, and his horizon was not limited to the home farm, for his elder brothers had gone out into the world, and of William he was proud from his youth up. A word about that particular elder brother.

William Hunter was born in 1718, and from childhood was destined for the church. He seems to have been an intelligent, sensible, attractive lad, eager in the pursuit of knowledge. At fourteen he was well advanced in his studies and was sent to the University of Glasgow. He became conspicuous there almost at once, but soon lost his purpose of being a clergyman. Meantime he had become intimate with William Cullen, six years his senior and a student of medicine. The intimacy bore fruit. Cullen, the future great teacher and clinician of Scotland, was astute even in his youth, and recognized William Hunter's abilities. So, upon Cullen's urging, Hunter entered on the study of medicine; from his nineteenth year to his twenty-second he was an inmate of Cullen's house. The next year, 1741, he spent in further study at Edinburgh, and then went to London to broaden his education and find a wider field for practice. It was a courageous undertaking and marks the man. Scotchmen were then few in London; George II was still living; Lord Bute did not come into power until eighteen years later, and Englishmen had not yet learned to complain that the King's favorite kept in his pocket all the offices and all the honors for his beggarly countrymen from beyond the border.

When William Hunter went to London he had to depend upon his little family estate, unusual gifts of brain power, a good education, and an introduction to Dr. James Douglas, an anatomist and obstetrician of some note. Douglas took a fancy to him at once; he received him into his house, made him tutor to his son, employed him as a prosector, secured for him a position as surgeon's pupil at St. George's, and procured for him first-class anatomic instruction under Dr. Nicholls. Douglas died, un-

* The parish register gives *13th* February, 1728.

fortunately, in the following year, but Hunter continued to live for a time in his family and rose rapidly in professional esteem. He soon began lecturing on surgery and anatomy, and proved himself one of the ablest and most popular teachers in England. In 1747 he became a member of the Corporation of Surgeons;* and in 1748 made a medical pilgrimage on the Continent. Then gradually he gave up surgery, to devote himself to obstetrics, anatomy, physiology, and general practice. In 1748 his brother John joined him in London, and in 1750 he received the degree of M.D. from Glasgow, his Alma Mater. The great Hunterian Museum of Glasgow was bequeathed by William Hunter to that University, and stands a splendid monument to its founder. He was now well launched upon his life-work, and there for the present we leave him; with this reflection, that his training and career were quite other than those of his more famous younger brother. He was an accomplished student and a university product. He was bred up in the best traditions of his profession. He was agreeable, spirited, interesting; an effective public speaker and a popular, inspiring, lucid teacher. Dignified, but apt, brilliant, and convincing in conversation, he was the friend of eminent men from his first coming to London. The best professional society frequented him, he became a member of learned bodies, and he held the respect and friendship of men of all ranks in that eighteenth century England.

John Hunter, such a rough lad as we have seen, went up to London, to his brother William, in the autumn of 1748. He was twenty years old. He went to London of his own motion, stimulated by the growing reputation of his brother, and his brother received him kindly. One may fancy the intercourse of this ill-mated pair, but William seems always to have been patient and generous. Such discord as arose was John's doing mostly. The lad was a bear, and very much of a bear he remained to the end of his days—jealous, rude, outspoken, much self-centered, intolerant; of an ungovernable temper, given to very naughty language, frequent with oaths. In his youth boisterous, a hard drinker and worse, he was fond of horse-play and addicted to low company, I fear; but always kindly, generous, impulsive, a staunch friend, a good hater. His professional ethics were second-rate, his contempt of empty dignities and humbug was shouted from the house-tops. But he was as sound and unreasoning a Tory as his contemporary, Dr. Johnson; and his patriotism was unswerving and articulate. He hated fiddlers, laced ruffles, and Frenchmen.

John Hunter was not the first of the brothers to be attracted by William Hunter's work in London. A few years before this his eldest brother James had given up the law and entered William's dissecting room, where he came to be regarded as a promising anatomist, in the course of a year. But his health gave out; he returned to the home in Scotland and died there. John Hunter was physically sound at the outset—fortunately for him and for us. He plunged into his work with enthusiasm and he

* The Corporation of Surgeons, under a new charter, became The Royal College of Surgeons in 1800, and took over the Hunterian Museum from the government.

clung to it for forty-five years. His brother William found employment for him at once, preparing a dissection of the muscles of the forearm in anticipation of his lectures, which began three weeks later. The young man had had no previous acquaintance with his subject, but succeeded so well that he pleased his elder, who continued to encourage him in such studies, until at the beginning of the second session he was given charge of the dissecting room and the instruction of the pupils. So he went on. It is easy to see where he got his knowledge of anatomy, but just where he acquired early that broad knowledge of the allied sciences and of general medicine is not so obvious. Hunter used to assert, and writers have continued to tell, how he was without a training in letters, and was ignorant of what his predecessors and contemporaries did for the science of medicine. It is hard unreservedly to accept such statements, especially when we know that in later life he was a constant associate of learned men and a valued contributor to their discussions. We know too that in 1748 William Hunter was a companion of such men, who made his house a rendezvous. So the younger brother, from his twenty-first year, breathed an atmosphere charged with things good for intelligent minds, and doubtless was encouraged to read as well as to listen and to think. From the first, however, he did his own thinking; there can be no doubt about that, as one sees from his givings-forth. Few young men have acquired formed habits at twenty, so that we may believe these new friends helped to direct his energies and to stimulate his ambitions. At any rate his brother had no intention that he should remain a mere hack, and so the year after John's arrival the youth was placed under the tuition of the famous Cheselden at the Chelsea Hospital.

It is worth our while to glance a moment at Cheselden, one of the most eminent of that school of ancient surgery which was passing—for the passing of which Hunter himself was to be in great measure responsible. **William Cheselden** was himself a pupil of William Cowper, an anatomist and surgeon of Stuart times, and almost a contemporary of Sydenham and Locke. Cheselden was educated at St. Thomas's Hospital, became an able anatomist and a skilful operator while a young man, and for more than twenty-five years was regarded as the leading surgeon in England. He perfected the lateral operation for stone; he was the first to operate for artificial pupil; he was a member of the Royal Society, Surgeon to St. Thomas's, St. George's and the Westminster Hospitals, and the last warden of the Barber Surgeons' Company, immediately before the separation of the surgeons and barbers in 1744. Moreover, he was a kindly, accomplished, forceful, well-bred man—a gentleman of the old school, our fathers would have called him, an impressive character and a notable teacher. So there we have John Hunter, living with his brother William, the accomplished scientist, and learning to practice under Cheselden, the foremost surgeon in the country—truly an admirable school for a rude country boy.

The young man's experience of teachers was to be varied further. In 1751 Cheselden retired from the Chelsea Hospital, the year before his death. Accordingly Hunter transferred himself to St. Bartholomew's,

where he became a pupil of Percival Pott, then in early middle age and vigorously at work. Pott was another admirable man, a man worth our acquaintance; a sound surgeon and a sound teacher, he was not yet known to fame, but was still in the enthusiastic, accumulating stage, when a man can do most for his pupils. He lived to be Hunter's rival and critic, but he always thought honestly and fought squarely.

Hunter remained with Pott for three years, and then, in 1754, became surgeon's pupil at St. George's, where he was appointed house-surgeon in 1756. Meantime, in 1755 his brother had entered him at Oxford, but he himself, at the age of twenty-seven, did not relish the idea and never kept his terms. The tale is often quoted that years afterward Jesse Foot, a surgeon and publicist, disparaged him for his ignorance of the ancient classics. Said Hunter, "Jesse Foot accuses me of not understanding the dead languages; but I could teach him that on the dead body which he never knew in any language dead or living." Hunter was never over-modest, and Foot was a foolish person, whose jaundiced "Life of Hunter" you shall read with groans.

Hunter chose St. George's because he had decided to be a surgeon, and because that hospital offered the best chance of future promotion. But he never neglected his anatomy in the midst of diverse other pursuits, and kept at work as pupil and tutor in his brother's dissecting room throughout those ten busy years. Hunter was as busy a man as Haller. We have seen Haller devouring books. However little or much Hunter did of that, he was a tremendous worker in his own line—laboratory research; and we shall hear how he was content with four hours of sleep, scanty rations, and little play. Even in those early years he was discovering things. Among other feats he solved the problem of the descent of the testis in the fetus, he traced the ramifications of the nasal and olfactory nerves, he tested experimentally the question whether veins could act as absorbents, he studied the formation of pus, and the nature of the placental circulation, and with his brother he practically proved the function and importance of the lymphatics.

All that brings us to 1759. He was now thirty-one years old; he had worked without ceasing in London for eleven years, and he broke down. That marks the end of his schooling and his youth. From now on we must think of him as the man of action—army surgeon, collector, investigator, teacher, writer, practitioner, and, toward the end, martyr to a fiery temper and a fatal, agonizing disease.

Hunter's breakdown in 1759 did not result seriously, though it disturbed his friends and alarmed himself. He was thought to have incipient phthisis, so he determined to find work and a residence out of England for a time. In the following year he secured a commission as staff-surgeon to Hodgson and Keppel's futile expedition to Belleisle—the same expedition which Thackeray has rendered forever comic in his account of Harry Warrington chased by the dragons. Hunter returned unscathed and the next year went to serve with the English forces on the frontier of Portugal. We cannot stop to learn of his army life except to note that for four years he was with the troops and acquired a great experience in

the treatment of gunshot wounds. He came to regard the presence in the tissues of a bullet as not in itself harmful, thus coinciding in opinion with his predecessor Paré. He was too intelligent and diligent a man to content himself with the mere discharge of his duties, arduous as they were, but was continually engaged in physiologic and other researches. He studied the conditions of the coagulation of the blood, he continued his old anatomic work, and he collected a great mass of memoranda on inflammations. In those years, too, he began his exhaustive researches into the habits, functions, and structure of plants and animals. He learned that digestion does not go on in snakes and lizards during hibernation, and that the creatures will die in that season if they are put through vigorous movements; so he was led to an interesting conclusion which he applied to his human patients; namely, that if the powers of a part are diminished through gangrene or local necrosis, stimulants are dangerous, since they "increase action without giving real strength." Soon after his return from Portugal he wrote out a catalogue of his specimens, and recorded notes of about two hundred normal and diseased structures. He retired on half-pay in 1763, at the end of the Seven Years' War, but those four years were not the least important for health and progress in his life, and he was wont to look back on them with satisfaction. The experience reminds one of what Darwin, Huxley, Beaumont, Reed and other distinguished men have known. There is place in the public service for scientific work of the highest type, as we have learned.

We find Hunter, then, at the age of thirty-five, in London, with a start still to make, on a short allowance, but splendidly equipped in courage, ability, and training for the task before him. He proposed to be a practising surgeon; meantime he must live. So he began teaching anatomy and operative surgery to private classes and renewed his acquaintance with the resurrection man. Such teaching was his forte. He never enjoyed formal lecturing; indeed, when he took up that work later, he did so with dread. He began each course with embarrassment and hesitation, and used to fortify himself with a large dose of laudanum before his introductory lecture.

Scant practice and a daily class would have left most men with abundant leisure, but Hunter had no leisure in life. He went on at once with the further study of comparative anatomy, and for subjects obtained animals dying in the Tower menagerie and in traveling zoölogical shows. He worked even when he was ill. They tell how he ruptured his tendo Achillis, and while so disabled experimented on the tendons of dogs. He devised the familiar operation of subcutaneous tenotomy, killed the animals at various stages of their convalescence, and through those studies ascertained the method and course of tendon healing. Out of such work grew the modern operations of that nature. In 1767 he was made a member of the Royal Society—a fact noteworthy, since he had as yet published but one brief paper, and his brother William did not receive the honor until several years later. Evidently the great ability of the younger man was already making itself felt. The next year, 1768, he was appointed surgeon to St. George's Hospital and became a member of the Corporation

of Surgeons, five years after settling to practise; and now he established that routine of daily life for which he was remarkable to the end. All great scientists have been workers, but Hunter worked in a fashion unknown even to our incessant modern life. He rose at five o'clock, and without waiting for a decent toilet hastened to his private dissecting room. There he worked until nine o'clock, when he snatched a hasty breakfast. He was methodical. From breakfast time until twelve he received office patients, and at twelve promptly, no matter who waited, he went out to make professional calls and his hospital visit. He returned home at four, and dined. He ate abstemiously and, for the last twenty years of his life, drank no wine. After dinner he slept for an hour, and at half-past five went to work again. Those evening hours were his most effective hours. He kept at it incessantly until after midnight, going to bed between one and two in the morning. He must have been a cheerful companion for his wife; for he married, of course, and in some fashion managed to beget and rear children. Mrs. Hunter was the daughter of a Mr. Home, a struggling army surgeon, and for this lady, in his early poverty, Hunter had to wait several years. He married her finally against the protests of his worldly-wise brother, whose opposition to the match is said to have been the beginning of that breach which finally separated the two men. John Hunter's wife was a good wife to him, though his selfishness and rough manners must have tried her sorely. She was a pleasant, social body, given to cakes and ale, and rather partial to those fiddlers and Frenchmen whom her husband abominated. Here is a sombre tale of social misadventure: "On returning late one evening, after a hard day's fag, he unexpectedly found his drawing-room filled with musical professors, connoisseurs and *other idlers*, whom Mrs. Hunter had assembled. He was greatly irritated, and walking straight into the room addressed the astonished guests pretty much in the following strain: 'I knew nothing of this kick-up, and I ought to have been informed of it beforehand; but as I am now returned home to study I hope the present company will retire.' "* He was a good old-fashioned British husband, and his sprightly wife remained faithful to him, though he bullied her while he lived and left her penniless when he died. Mrs. Hunter had a younger brother, Everard Home, twenty years Hunter's junior. The lad became a member of their household; studied surgery under his distinguished kinsman, was taken into his confidence, was made his assistant, partner, and executor, grew to fame on his fame,—Home was not without ability of his own,—and made himself forever infamous, long afterward, by burning a great collection of the Hunterian manuscripts in order to conceal his own literary pilferings—a scandal with which scientific London blazed in the early years of the last century.

In 1768, then, John Hunter found himself well established; he moved shortly afterward into his brother's former house, and began to take house-pupils—many of them afterward famous. Of such pupils were Jenner, Guy, our own Physick, Lynn, and Carlisle. At St. George's he had Aber-

* Ottley.

nethy, Cline, Earle, and Astley Cooper, and he taught those young men to work as he worked himself. Early in his career Hunter recognized that, as yet, comparatively little had been done to explain the nature of disease, its significance, its relation to health, its progress, and its classification. Again we are confronted with the problem of Hunter's ignorance or familiarity with the accomplishments of other workers. Of course, he must have known the broad outlines, the common property of all physicians of his time, but he often seemed to feign ignorance, or, what is more probable, he distrusted published conclusions, and had pretty steady contempt for the capacity and observations of his fellows; not that he trusted himself implicitly, though he thought well of John Hunter; but he used to tell his pupils not to refer to what he had said the year previously, for he reserved to himself the right of changing his conclusions. At any rate, Hunter, unlike Paré, perceived that medicine was in its infancy, and he undertook the stupendous task of revolutionizing ancient methods of study and launching science anew upon sound and rational lines. He began with fundamentals; he insisted upon a review of anatomy; and he taught that a thorough knowledge of embryology is essential to an intelligent pursuit of anatomy. Not only that, but he perceived the significance of the structure of animals of varying types, and of plants too. He had more than a suspicion of the evolution of species and their origin, and insisted that a foundation in medical knowledge could be acquired only from an exhaustive study of comparative anatomy and of animal and vegetable life. In such studies and in such teaching he was unwearied. Read his works and you shall find an astounding variety of evidence that he had anticipated a thousand modern discoveries and had constructed hypotheses which have been adopted since as some of the important theories of recent research. Not content with such work, he was indefatigable in his investigation of physiologic problems in man, animals, and plants. In his own laboratory and with the rough tools at his command he performed experiments and reached conclusions not unworthy of a Harvey, a Haller, a Spallanzani, a Bichat, or a Claude Bernard; and he inspired with a like diligence and enthusiasm the few choice spirits who had the wit to appreciate his greatness and the courage to follow his lead. They were young disciples. Among his contemporaries he had no following. What great man's contemporaries ever did become his followers? Maturity does not seek novelty. The prophet must have young men about him if his words are not to fall fruitless. Were progress to depend upon a man's contemporaries, we should be in the stone age still. New life, new blood, fresh enthusiasm, and vigor are needed for advance. The "judgment of experience" expresses the recognition of familiar conditions; and experience is palsied in the face of novelty.

Fundamental work was Hunter's great work. It is for such that we hold him in the front rank of all our benefactors. He saw the meaning of science more clearly than any man who had lived; and he had the genius to make others see that meaning. That marks him as it marks the few rare spirits of his kind to whom men have given ear.

Hunter was not infallible. He made many mistakes; for he strove

much and often, and such constant strivings end sometimes in error. But he was luminous and articulate to show the way, not hoping in one short life to reach the goal of all knowledge, but confident that from his Nebo his successors should advance upon the land which to him was vouchsafed as a vision only.

Hunter's method was rigid adherence to deduction founded upon observation and experiment; and his studies embraced an enormous field. Let us pass in brief review some of his better known contributions to science: In 1772 he published his first paper in the "Philosophical Transactions," an essay on post-mortem digestion of the stomach, in which he explained that phenomenon as a result of the action of the gastric juice. In 1771 and 1778 appeared his essays on the teeth, whose natural history was explained and their diseases exhaustively considered. The work was an authority for three generations. In 1774 he read before the Royal Society a paper on birds, describing their manner of breathing; and a paper on the stomach of the Gillaroo trout. During these same years he was busy with investigating the temperatures of animals under varying conditions, and his letters to Jenner, his constant correspondent, describe his elaborate clinical thermometer in a fashion worth reading. Such investigations led to a delightful paper, which he read before the Royal Society in 1778, on the "Heat of Animals and Vegetables."

Two years afterward, in 1780, Hunter presented to the Royal Society a paper which precipitated a bitter quarrel with his brother William, a quarrel which was healed a few days only before the elder's death, three years later. John Hunter's paper dealt with the structure and circulation of the placenta, with facts which he claimed to have discovered and established many years before, when working in his brother's dissecting room. Now, William Hunter had published the same observations in his work on the "Gravid Uterus" in 1775. The lie was given and returned publicly between these eminent men, and the Royal Society refused to print John Hunter's paper. He acted badly, whatever the rights or wrongs in the case may be. In this same year of 1780 Hunter read before the Society an account of a fetus, dead of smallpox, and a paper on the change of plumage in non-breeding hen-pheasants. In 1782 there followed an essay on the organ of hearing in fishes.

Lectures, essays, letters, flowed from him continually during these years, but it was in 1785 that he made the observations and performed the operation for which he is best known to students of surgery—Hunter's operation for aneurism. The story is interesting and illustrates the man. He happened in that year to be studying the mode of growth of deer's antlers. In July he had a buck caught, and tied one of its external carotid arteries. He observed that the antler which was nourished by this vessel became cold to the touch, and he debated whether this antler would be shed in due course or would be retained longer than usual. To his surprise he found, two weeks later, that the wound was healed and that the antler was again warm and vigorous. He supposed the ligature might have slipped, so he had the animal killed, when on examination he was interested to discover that the ligature held, but that, through anastomosis

and enlargement of small vessels above and below the occluded part, normal circulation had been restored to the growing antler. From this observation he was led to the conclusion that "under the stimulus of necessity" the smaller arteries are capable of rapid increase in size to perform the function of the larger.

Soon afterward he had an opportunity of applying to a human patient this newly discovered law. There entered the wards of St. George's Hospital a man suffering from advanced popliteal aneurism, and in approaching the case Hunter debated whether to employ the old method of Antyllus,—dissection and double ligation,—or to follow the practice of Pott, amputation well above the aneurism, declared by Pott to be the only safe method. Hunter was conservative in his practice. He abhorred meddlesome surgery, and used the knife when other means had failed only. He felt the operation of Antyllus to be dangerous, and the method of Pott to be needlessly severe. He argued, however, that it would be reasonable to tie the femoral artery at that safe point where Pott would tie it in an amputation. He would not amputate, however, but would count upon the anastomosis for restoring circulation to the leg. Accordingly, he acted upon this reasoning, and with success. He tied the vessel in that intermuscular space known since as Hunter's canal, and was gratified after several hours to find that the temperature of the foot had not fallen, but had risen above the normal. The patient progressed satisfactorily, and six weeks later, with a sound and useful leg, was discharged from the Hospital. The fame of this operation went abroad and aroused commotion. Promptly Frenchmen and Italians claimed priority for their countrymen, while many English surgeons, headed by the veteran Pott, denounced the procedure as dangerous and unwarrantable. But it gained ground and became accepted in spite of loud words. Wise men waxed enthusiastic over it, and the Italian Assalini, who saw it first performed, testified that it "excited the greatest wonder, and awakened the attention of all the surgeons in Europe."

In 1783 Hunter had taken a leading part in establishing the "Society for the Improvement of Medical and Chirurgical Knowledge," and several of his papers were read subsequently before that body. In that same year he read to them an admirable paper on "Phlebitis," the first paper we have which gives a satisfactory explanation of that affection; and in 1786 he gave to the world his famous book "On the Venereal Disease," a book long awaited by the profession, and an authority for fifty years thereafter. A few months subsequent to its appearance he published his work on the "Animal Economy," a collection of important papers consisting of many admirable anatomic descriptions, and accounts of numerous original researches in physiology. In 1787 he gave to the Royal Society a paper on the "Wolf, Jackal, and Dog," and a second paper, well illustrated, on the structure and physiology of whales.

In those years Hunter was overwhelmed with a thousand cares, and suffered much in health, so that his writings were few and at long intervals after 1787. In 1792, the year before his death, he contributed to the "Philosophical Transactions" a paper on bees, the result of his observa-

tions on the hive-bees, studied for more than twenty years. His last printed book, a book regarded at the time as the most important of his productions, was posthumous, the final editing being done by Everard Home; its title, "A treatise on the Blood, Inflammation, and Gunshot Wounds, 1794."

Thus, in a few words, I have told something of the more notable things which Hunter did, but the story is very bare. It would be interesting to look out with him upon the world in which he lived and learn something of what other men were doing. The influences which bore upon him, and the condition of Europe in that last half of the eighteenth century, were vital and remarkable. Politics and literature, philosophy and science, were undergoing profound impressions. Hunter was no closet student, but a man keenly interested in what was doing, and for long much in the eye of the scientific world. All this must be a passing thought, however, but we may glance again at Hunter's life, his later years, and bring our story to a decent close.

One recalls certain facts not altogether agreeable or attractive, minor faults of temper and habit. His body was grievously overdriven by an iron will, so that there resulted ill health and a vicious temper, with which he struggled for years. Certain it is that he suffered from angina pectoris, and found little relief. Overexertion brought on frequent attacks, and outbreaks of passion or the attempts to suppress passion were a constant dread to him. So far back as 1772 he began courses of systematic lectures which were a severe strain upon him, owing to his painstaking method and labored delivery. He published his lectures later—a standard work of immense learning and rare originality.

In spite of his labors and fame he never made much money, and what he did make went for specimens and apparatus. He was one of the greatest collectors ever known, and scoured the world through friends and messengers for the flora and fauna of all lands. Dozens of his letters to Jenner deal with the habits of the cuckoo; he sent a special expedition to the Arctic for specimens of the whale and paid five hundred pounds for the skeleton of an Irish giant.

I have said that it was Hunter's conception and teaching of science which mark him the great man, but to his immediate successors and to the casual reader of today he is best known for his museum. The Hunterian Museum was the means to an end, but it was a magnificent means. Measured in bank-notes, it cost him upward of three hundred and seventy-five thousand dollars. After his death it was sold for seventy-five thousand.

Hunter seems to have valued money as of service only to enrich his collection. Up to 1780 his income ranged between five and ten thousand dollars a year. For a few years before his death it reached twenty-five thousand, and in one year more than thirty thousand dollars. Most of his contemporaries regarded his love of collecting as an eccentricity and his devotion to science as almost a mania. Few perceived the drift of his biologic researches, and his investigations in comparative anatomy were looked upon as works of unprofitable curiosity. Even his friend, Sir Joseph Banks, the president of the Royal Society, wrote, three years after

Hunter's death, that he did not believe the Hunterian collection to be "an object of importance to the general subject of natural history, or indeed to any branch of science except to that of medicine."

The collection is estimated to have contained 13,682 specimens: In the physiologic department, 7295; in the pathologic, 2678; and 3709 fossils. In the year 1800 it was acquired by the Royal College of Surgeons, since when it has been greatly increased, thanks largely to the efforts of its distinguished line of custodians, William Clift, William Home Clift, Richard Owen, J. T. Queckett, and William Fowler.

A writer* has defined the scope of these labors of Hunter as the explication of the various phases of life exhibited in organized structures, both animal and vegetable, from the simplest to the most highly differentiated. Hunter did not employ comparative anatomy in subservience to the classification of living forms, as did Cuvier, but in order to ascertain the principle which animated and produced those forms—a principle by virtue of which it appeared that all forms were allied to himself. He was continually asking himself, In what does life consist? He came to teach that "life is a principle independent of structure, most tenaciously held by the least highly organized beings." Abernethy says he perceived life to be "a great chemist," a power capable of manufacturing a variety of substances into one kind of generally distributed nutriment, and of furnishing from this a still greater variety of dissimilar substances. Hunter found, in short, that there exists in animals a latent heat of life set free in the process of death. "Mere composition of matter," said he, "does not give life; for the dead body has all the composition it ever had; life is a property we do not understand." As a bar of iron may gain magnetic virtue by being placed for a time in a special position; so, perhaps, the particles of matter arranged and long continued in a certain posture eventually gain the power of life. "I inquired of Mr. Hunter," writes Staple, "if this did not make for the exploded doctrine of equivocal generation; he told me perhaps it did; and that as to equivocal generation all we could have was negative proofs of its not taking place. He did not deny that equivocal generation happened."

Hunter held certain interesting views on geology. In water he recognized the chief agent for producing terrestrial changes; but he held untenable the popular notion that Noah's deluge might account for the marine organisms discovered on land. From the diversity of the situations in which many fossils and allied living structures are found he was led to infer that at various periods there had taken place not only repeated oscillations of the level of the land, lasting thousands of centuries, but also great climatic variations. The following striking paragraph of Hunter's is from Butler's essay: "If we were capable of following the process of increase of the number of the parts of the most perfect animal, as they first formed in succession from the very first to its state of full perfection, we should probably be able to compare it with some of the incomplete animals themselves, of every order of animals in the creation,—being at no stage different from some of those inferior orders; or, in other words, if we were to

* F. H. Butler.

take a series of animals from the most imperfect to the perfect, we should probably find an imperfect animal corresponding with some stage of the most perfect." In spite of involved phrasing, this thought, coming to us out of the eighteenth century, is supremely interesting.

Such were some of Hunter's labors and teachings. Like every genius he kept himself young, and projected himself beyond his generation. As he advanced in years and grew to fame his fits of temper and his intolerance of opposition increased upon him. It was his temper that killed him. He had become unavoidably concerned with medical politics—a field in which he was not calculated to shine. There came to be bad blood between himself and his colleagues at St. George's because he announced that they were neglecting the surgical pupils and that thereafter, as he was doing most of the work and attracting most of the students, he should not turn in the fees to the common purse, but would keep them for himself. The governors of the Hospital ruled against his decision, and provided, in addition, that thereafter no student should be admitted who had not been educated in medicine. This last rule seemed to be aimed at Hunter. It irritated him particularly because, soon after, there came up to London two young Scotchmen, ignorant of the new law but seeking to be taken on as his pupils. He explained to them the situation, but promised to do what he could. For that purpose, on the 16th of October, 1793, bent on seeing his Scotchmen through, he attended a meeting of the Hospital Board. Ottley tells the story: "Arrived at the Hospital he found the Board already assembled, and entering the room presented the memorial of the young men, and proceeded to urge the propriety of their being admitted. In the course of his remarks he made some observations which one of his colleagues thought it necessary instantly and flatly to contradict. Hunter immediately ceased speaking, retired from the table, and struggling to suppress the tumult of his passion, hurried into the adjoining room, where, with a deep groan he fell lifeless."

It is a pathetic and tragic scene. One fancies the winged words that may have passed, the taunt of that nameless colleague, who was probably in the right, the fury of Hunter, who was probably in the wrong. Rembrandt should have lived, and added that picture to his collection. The fate of those two disappointed young Scotchmen has not been told.

Look back the hundred and thirteen years which have passed since Hunter died; think what his life means for science and what is the estimate placed upon it by the average physician of today. The Englishmen have done their best for him, to be sure. Two of his influential relatives established the annual Hunterian Oration, which survives; but in the profession at large he is little more than a myth. A recent publicist says of him, that he stands for a book of surgical lectures, a treatise on venereal disease, and the operation for aneurism. He stands for far more. Those things were by-products dropped from the seething laboratory of his brain. He means for us the first and the greatest English-speaking exponent of proper scientific research. He is the father of us all, physicians, surgeons, laboratory students, for he wrought mightily in all fields.

John Hunter inspired little personal affection or devotion, though he

inspired admiration and respect, for his was a vast genius. His disciples recognized the genius; few loved the man. With him it was not, as with Hippocrates, or Paré or Boerhaave or Haller. It was a fiery soul—onrushing, fierce, eager, intolerant, unsparing of others as of himself; the body exhausted out of season, the task unfinished; but his works do follow him. In modern days only have we come to see that sound knowledge and appreciation of science must be sought along those lines laid down through toil, criticism, and weariness by the indefatigable John Hunter.

AMERICAN SURGERY.

It is interesting, before going on with the narrative of world surgery, to glance more particularly at the progress of surgery in this country, so far as one may in brief retrospect and without becoming involved in a discussion of the achievements of living men.

The best early American surgery grew out of English surgery, with John Hunter as the prophet, and as our best surgery was for nearly a century dependent on the teachings of Europe, it may be divided conveniently into three eras: the Hunterian era, the middle or French era, and what we may call the German-American era. Let us note, then, some of the great American surgeons in each of these periods and recall a few of their important deeds, but with this prefatory consideration; until within recent years American life has furnished little opportunity for the closet student and the laboratory student of science. Some great surgeons have lived and flourished among us, but the stress of life and the circumstances of their being have forced them into practical work, into personal relations with their fellows. With a few exceptions they have created no great new thing, but they have been able exponents of borrowed work, and they have been daring practical operators of the highest type. It is a story of great clinicians.

John Jones.—American surgeons must look back to John Jones, of New York, as the first of their eminent professional forebears. Jones was born in New York city in 1729, so that he was a contemporary of Washington. He did his work in his native place, and there he died in 1791, at the age of sixty-two. It is a forceful, sterling character, of value in those days to the patriot cause in arms. Jones may be called a disciple of the Hunterian era, though in fact he was but one year younger than John Hunter himself. But Hunter and Jones studied in the same schools and knew the same masters, and the younger man came to be influenced greatly by the work and teaching of his more famous English contemporary. Jones studied in London under Percival Pott; in Paris under the great French reformers, Petit and LeDran, and in Edinburgh under the elder Monro. He became distinguished in colonial annals as surgeon to the troops in the old French War of 1758, and then, upon the foundation of King's College, he was made the first Professor of Surgery, in 1767. The chroniclers note of him that he was the first American to perform the operation of lithotomy.

John Jones' most conspicuous work, and that for which he is commonly quoted, is his book entitled "Plain, Concise, Practical Remarks on the Treatment of Wounds and Fractures," New York, 1775, reprinted at Philadelphia in the following year, with Van Swieten on "The Diseases Incident to Armies and Gunshot Wounds." This little book became the *vade mecum* of Continental surgeons during the Revolutionary War. Jones attempted little more in it than to condense the teachings of Pott and LeDran; but there are a few notes of originality, the most conspicuous being a case of trephining in delirium, eighty days after a slight head injury. The dura was opened and drained and the patient promptly recovered.

After the war, Jones went on with his teaching and practising until his death. He was a useful and honorable man, an admirable type of the best of that long line of surgeons with whom we have to deal.

William Shippen, Jr.—The second of our early surgeons, a contemporary of Jones, was William Shippen, Jr., of Philadelphia. Like Jones, and like most of the men of his own and the succeeding generation, he was admirably educated in foreign schools. Shippen was born in 1733 and studied in Leyden, Edinburgh, and London. He was a special pupil of William Hunter. To us he is memorable for two things: with John Morgan he founded the medical department of the College of Philadelphia (later the University of Pennsylvania) and he served with distinction as Physician-General to Washington's armies from 1777 to 1781. Next to Morgan and Rush he was probably the most distinguished American physician of his generation, and the conduct of his department during the war was admirable and creditable. Though an able and popular teacher he seems to have added nothing of importance to the science or art of surgery.

John Warren.—Somewhat younger than the two distinguished representatives of New York and Philadelphia was John Warren, of Boston; indeed, he belongs almost to another generation. Warren was born in 1753, a younger brother of that General Joseph Warren, famous as a hero of Bunker Hill. Unlike Jones and Shippen, Warren found his education entirely in America; but, in spite of this apparent disadvantage at the start, he is eminent in our annals as a great clinical teacher and surgeon, and as the founder of the Harvard Medical School. So one observes that these three men, our first distinguished surgeons, living haply in different towns, are notable chiefly as founders and first surgical professors in our three oldest and most famous medical schools. Warren served with distinction as hospital surgeon during the Revolution. For some months before the conclusion of peace he was in charge of a great military hospital in Boston, where he found material and opportunity for teaching and operating, and it was almost immediately after the dissolution of this hospital that he assisted in the foundation of the medical school, in which he was appointed to the chair of anatomy and surgery, where he labored until his death in 1815.

American surgeons will remember that we owe more than a casual glance at these three men. In the straitened and difficult circumstances of our colonial and early national life, the foundation of schools and hos-

pitals was a gigantic task; for be it noted that hospitals often followed or were associated with the foundation of schools. In England hospitals long antedated schools, and out of hospitals schools arose. Our surgeons, living in sparsely settled communities, where extreme poverty was little known, were able to bring about the foundation of hospitals with difficulty; but the need of proper medical education appealed more directly to their constituents, so with the beginnings of our national life schools sprang up here and there, and with the development of a more complex civilization, hospitals, too, came to find their place.

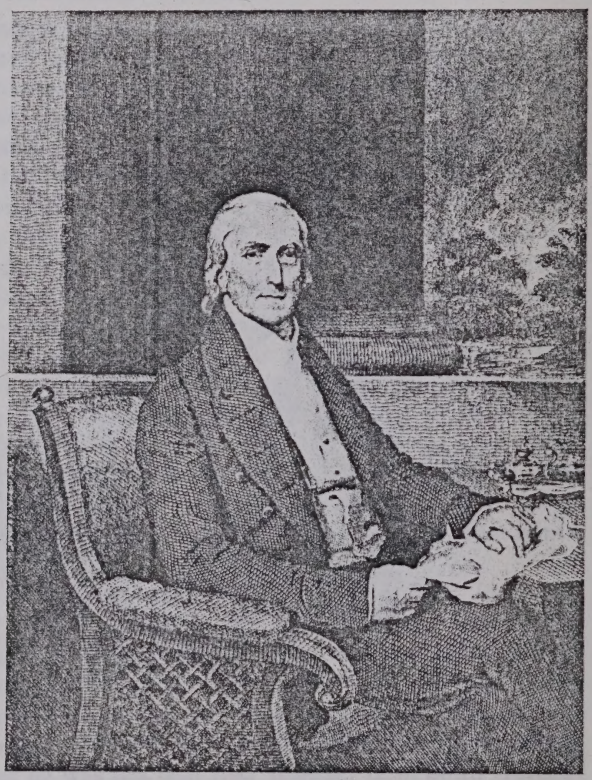

FIG. 5.—PHILIP SYNG PHYSICK.

Partly, perhaps, on account of the paucity of schools and hospitals, and partly owing to the strenuous forward march of our civilization, behind which schools and hospitals lagged for many years, we find that all of our great early surgeons are not to be discovered in the medical centers. The seaboard towns furnished admirable and well-equipped practitioners; but able practitioners were found on the frontier also, and when we come to study the surgical annals of the last century, we encounter records of accomplishment not alone in the Eastern States, but we hear of voices raised in the western wilderness.

Philip Syng Physick, called the Father of American Surgery, is perhaps the most widely known surgeon in our annals of the last century. Certainly he should head the Hunterian era among us; for he was a personal friend and pupil of John Hunter and his life was dedicated to practising and teaching the principles of that great man. Physick was born in Philadelphia in 1768; was educated in Edinburgh and London and became surgeon to the Pennsylvania Hospital in 1794. In 1805 he was appointed to the chair of surgery in the University of Pennsylvania. Unfortunately, he contributed little to the literature of surgery and his fame rests on the tradition of his operations, the tales of his pupils, and the compend of his practice, published by his nephew, Dorsey. Physick maintained the unfortunate sedentary habits common to his generation, and encouraged thereby a chronic dyspepsia, a recluse temperament, and a somewhat morbid view of life. He is not an interesting character; but he was a profound student, a clear-headed practitioner, and an ingenious mechanician. In a multitude of ways he improved the technic of American surgery, and seems to have done faithfully and well whatever he attempted. He bettered the famous long splint of Desault; he performed internal urethrotomy for stricture; he employed the seton for ununited fractures; he invented the stomach-pump for cases of poisoning; he bled to depletion preliminary to reducing long-standing dislocations; he was a lithotomist, and at the last, in his terror lest his body be dissected, he provided that the corpse should be guarded for many weeks after his decease.

Wright Post.—After Physick there are two New York surgeons, Post and Mott, who are worthy of our study. Mott's is the greater name, but Post was the first New York surgeon of eminence in the nineteenth century. Wright Post was born in New York in 1766, nine years before the outbreak of the Revolution. He studied in London under Sheldon, and six years after his return home was appointed Professor of Surgery in Columbia University, in 1792, when he was but twenty-six years old. He taught and practised for thirty years longer and died in New York in 1822. The man is notable as a daring operator and skilled anatomist. He first, in this country, in 1796, performed Hunter's operation for aneurism of the femoral artery; in 1817 he ligatured the subclavian artery in its outer third, and in 1813 he ligatured successfully the external iliac artery—the second operation of its kind to be performed. His name is familiar, and was famous among New Yorkers one hundred years ago.

Valentine Mott was nineteen years junior to Post, and lived down to modern times. I know of no man more famous among New York surgeons. His life is an inspiration to students; but we have space for the briefest outline only. He was born on Long Island in 1785. He died in 1865, the last year of the Civil War. After his graduation in medicine from Columbia in 1806, Mott studied for some years in London, part of the time under Astley Cooper, and returned to this country in 1810. He was appointed Professor of Surgery in the Columbia School and retained the chair when that school was merged into the College of Physicians and Surgeons, in 1813. He was a teacher all his life and in sundry schools. His

private classes were large and lucrative. In 1826 he was for a time Professor of Surgery in Rutgers College; and again in the College of Physicians and Surgeons, resigning in 1834. In 1840 he became Professor of Surgery in the University of New York, and finally, in 1852, retired with the title of Professor Emeritus; even then he continued his annual course of lectures until his death, at the age of eighty.

To the student of surgical history the reason for Mott's permanent fame are not altogether clear, but among his contemporaries he was regarded as an heroic figure. He was a man of distinguished presence, of instant popularity, courtly, kindly, polished, with a sound and wide-grasping mind, highly cultivated under the best teachers, with a far-reaching ambition and an intimate knowledge of professional needs in our developing American life. He did a great number of things and he did them boldly and skilfully. His fame became established through his ligature of the innominate artery, for the first time on record, in 1818. The case must be counted as unsuccessful, though the patient lived several weeks, and it is worthy of note that the first successful case of the kind was in the hands of another American surgeon, A. W. Smythe, of New Orleans, who performed his operation in 1864. Mott is known to us especially for his work on aneurisms. He tied the common iliac in 1827, and during his career he was able to record the ligature of 132 of the great vessels, including 8 of the subclavian, 51 of the common carotid, 6 of the internal iliac, 57 of the femoral, and 10 of the popliteal. In 1828 he removed the entire clavicle, for osteosarcoma, and he was wont to refer to this as his Waterloo operation. In 1821 he excised the right half of the lower jaw, unaware at the time that a similar operation had been performed in 1810 by W. H. Deadrick, of Tennessee. It is needless to rehearse the multitude of Mott's performances. They were regarded as epoch-making; but enough has been said to illustrate the man and the distinction of a character which is still numbered among the greatest of American surgeons.

Ephraim McDowell deserves our gratitude; his life was romantic and his fame posthumous. He was born in Virginia in 1771, and removed when a boy to Kentucky. With the exception of one year, 1793, spent in Edinburgh under John Bell, his life was passed in Kentucky, where he practised at Danville. In 1809 he performed ovariotomy. In 1817 he reported this case with two others in the Philadelphia "Eclectic Repertory,"* but the world regarded him not. It was only in later years that the greatness of his performance became recognized, and now he has long been known as the pioneer ovariotomist.

With McDowell one couples **Nathan Smith,** another frontiersman in American surgery, though he lived in New England and was widely known as teacher and physician. Smith was born in 1762 in Massachusetts, and grew to manhood a farmer's boy in Vermont. Then ambition seized him; he returned to his books, studied under a preceptor, was graduated in medicine from Harvard in 1790, and founded the Dartmouth Medical School. There he did almost all the teaching for many years, occupying

* "Eclectic Repertory and Analytic Review," vii, p. 242. Philadelphia, April, 1817.

what Holmes has wittily described as not a "Chair" but a "Settee of Professorships," until he had placed the department upon a strong foundation, when, in 1813, he accepted the chair of medicine and surgery in the newly established Yale Medical School, at New Haven. His fame rests upon his founding of Dartmouth, his teaching of clinical medicine,—notably his exposition of typhus fever,—and especially upon his work as a surgeon; for he, too, was a pioneer ovariotomist. He operated upon his much quoted case in 1821, ignorant of McDowell's work. He tied off and dropped the pedicle, which McDowell had not done, and his patient recovered. Smith's life was crowded with teaching, writing, and practice; and he left a reputation which has endured.

FIG. 6.—EPHRAIM MCDOWELL.

John Collins Warren.—After Physick and Mott, John Collins Warren is probably the most eminent American representative of our Hunterian era. He was the eldest son of John Warren and was born in Boston in 1778, four years before the founding of the Harvard School. Unlike his father, he received a foreign education, studying in Paris and Edinburgh, and in London under Astley Cooper. For more that fifty years he was the leading surgeon of New England. He was Professor of Anatomy and Surgery at Harvard, and with James Jackson founded the Massachusetts General Hospital in 1811, where he served as senior surgeon for more than thirty years. As time develops and we get a better perspective of Warren's

life, we are coming to appreciate his great service to American surgery and to American medical education. He was one of the early presidents of the American Medical Association. As an operator he was exact, painstaking, rapid, and successful. His observations were sound, his writing lucid and instructive. He was one of the first in this country to excise the hyoid bone, to perform osteoclasis, excision of the head of the humerus, staphylorrhaphy, and external urethrotomy, and his work on the excision of tumors is notable. He organized a great hospital on lines and with methods which persist to this day, and, most important of all, he first dared to employ ether anesthesia in surgery, in the year 1846. The story of the great ether controversy—who discovered anesthesia?—is more than a twice-told tale, and needs no rehearsing now. A word, though, about

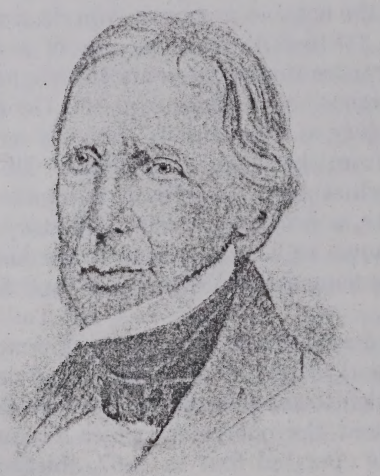

FIG. 7.—JOHN C. WARREN.

the significance of that same anesthesia. Before its time surgical operations were dreadful things—a hell to patients and a purgatory to operators. Indeed, most of the great and humane surgeons hated and dreaded severe operations. John Hunter is often quoted as asserting that an operation is a confession of failure, and is the last resort of our art. Cheselden, Brodie, Warren, Liston, Simpson, and dozens of others bore similar testimony. The frightful shrieks from ancient hospital amphitheatres still ring in the ears of those of us whose ears are open.

As a consequence of such conditions, operations were rare in civil practice. Keen* has given some interesting figures: "It is a striking commentary on the immediate results of anesthesia to learn that in the five years before the introduction of ether (1846) only one hundred and eighty-four persons were willing to submit themselves to such a dreadful ordeal in the Massachusetts General Hospital—an average of thirty-seven operations

* Keen: "Addresses and Other Papers," p. 287.

per annum, or three per month. In the five years immediately succeeding its introduction, although the old horror could not at once be overcome, four hundred and eighty-seven operations, or almost one hundred annually, were performed in the same hospital. During 1898 in the same hospital * * * over 3700 operations were performed."

Anesthesia did not spring full-fledged from darkness. For years men sought it, and some thought they had found it. It was a shrewd American dentist, **W. T. G. Morton,** who established publicly the use of ether as a safe and sure anesthetic, in 1846. His first demonstration was made on October 16th of that year, at the Massachusetts General Hospital in Boston, and John Collins Warren, the senior surgeon, then in his sixty-ninth year, was the daring operator to sanction and utilize the experiment. For several years Morton had considered this question of anesthesia. He had seen nitrous oxid tried, and he had experimented with sundry substances. C. F. Jackson, the chemist, had encouraged him to employ sulphuric ether, which he did by tests upon animals, upon himself, and upon one other patient before making his public demonstration. The achievement was an admirable piece of scientific work, for which the man received scant reward. However, anesthesia was accomplished: the use of ether, and the next year of chloroform, became universal throughout the civilized world, and the science of medicine moved forward into the antiseptic era, which occupied the next generation. Though Warren did not *discover* ether anesthesia, the profession must not forget its debt of gratitude to him for courageously seconding the discoverer and risking his great reputation and his patient in an unexplored field. Warren died in 1856, having lived to see his son, J. Mason Warren, associated with himself as colleague at the Massachusetts General Hospital. After a successful career J. Mason Warren in turn was succeeded in the same hospital by his son.

Mott and Warren may be regarded as the last American exponents of the Hunterian era.

The middle American period is rich in conspicuous names and is notable for two events—the introduction of ether anesthesia and the surgery of the Civil War. Most of the men famous in this period were educated in Europe, because to Europe we still turned for the best original work in science and for the experience of great clinics. With the Napoleonic era the Paris school became conspicuous and popular. It was favored by the Government and unusual opportunities were offered there for the study of anatomy and clinical surgery. Less and less, as time went on, do we hear of Americans in Edinburgh and London; but the results of the Paris teaching were being felt, and we were developing rapidly a new generation of practitioners in America. Conspicuous among these were the Philadelphia group. There was **William Gibson** (1788–1868), born in Maryland, Professor of Surgery in the University of Maryland in 1812, and in the University of Pennsylvania from 1819 to 1855. He published his "Institutes and Practice of Surgery" in 1824, and the book went to the eighth edition. Gibson was the first to perform ligation of the common iliac (1812); and he operated twice upon the same patient by Cæsarian section.

John Rhea Barton, born in 1794, was surgeon to the Pennsylvania Hospital. He is known especially for his work upon bones and joints, and with his name is associated a form of fracture of the lower end of the radius, Barton's bandage for fracture of the jaw, and osteotomy for ankylosis of the knee, first performed by him in 1826. In 1834 he wired a fractured patella. He died in 1871.

George McClellan was born in 1796. He was a pupil of Dorsey, Physick's nephew, and was graduated from the University of Pennsylvania in 1819. McClellan will always be known as the founder of the Jefferson Medical College of Philadelphia in 1824, where he held the chair of surgery until 1838. He was a brilliant operator, bold and confident. He excised the lower jaw in 1823, and the parotid gland; and was one of the first to remove the entire scapula and clavicle for malignant tumor. The clavicle had previously been excised for necrosis, and for the first time, by McCreary of Kentucky, in 1813; while the entire scapula, three-fourths of the clavicle, and the arm were excised for the first time, and successfully, by Dixi Crosby of New Hampshire, in 1836. McClellan died in 1847 at the age of fifty-one.

Another distinguished Philadelphian was **George W. Norris** (1808–1875), a graduate of the University of Pennsylvania in 1830. He was surgeon to the Pennsylvania Hospital and Professor of Clinical Surgery in the University; and his valuable statistical contributions to practical surgery, published between 1828 and 1854, rank him among the best surgical writers of his day.

Thomas Mütter, born in 1811 in Virginia, was graduated from the University of Pennsylvania and became Professor of Surgery in the Jefferson Medical College. He is celebrated for his plastic operations for extensive scars. He died in 1859. The Mütter Lecture and the Mütter Museum of the College of Physicians of Philadelphia are notable foundations due to his generosity.

Daniel Brainard was born in Western New York in 1812, was graduated from the Jefferson Medical College in 1834, and settled in Chicago. He amputated at the hip-joint in 1838, but his most famous service was the founding of Rush Medical College of Chicago.

Other distinguished Philadelphians were **Joseph Pancoast** (1805–82), in 1838 elected Professor of Surgery in the Jefferson Medical College, a strong writer on surgery and distinguished for his plastic operations, resection of nerves, and his work on ununited fractures; **Henry H. Smith** (1815–90), Professor of Surgery in the University of Pennsylvania in 1855; **Francis Maury** (1840–79), the first in this country to perform gastrotomy; and **D. Hayes Agnew** (1818–92), who taught first in the Philadelphia School of Anatomy,* and later became Professor of Surgery in the University of Pennsylvania. He published "Principles and Practice of Surgery"

* This school was founded in 1820 and was a "School of the Prophets" in training future professors in many departments of medicine. It ceased to exist in 1875, having had a longer existence as an extramural teaching institution than any other such school except that of the Hunters in Great Windmill Street, London. A history of the school has recently been reprinted by W. W. Keen in a volume of "Addresses and other Papers."

and was for more than a generation a famous and highly esteemed practitioner and teacher.

In New York during this middle period were **J. Kearny Rogers** (1793–1851), an able surgeon of the New York Hospital, and **Willard Parker** (1800–84), a Harvard graduate and pupil of John C. Warren. Parker's was a remarkably successful and conspicuous career. He was a teacher in many schools, in Berkshire, Cincinnati, and the College of Physicians and Surgeons in New York. He was a surgeon to Bellevue and the New York Hospitals. Billings says that he was the first to operate for strabismus in this country. More than that, though he was not the first surgeon to operate for abscess resulting from appendicitis, his paper in 1867 was the first which compelled the profession to recognize the need for operation.

Bigelow is one of the notable names in American medicine. **Henry J. Bigelow,** of Boston (1816–90), was the son of a distinguished father, Jacob Bigelow. For more than fifty years the younger Bigelow was eminent. Appointed surgeon to the Massachusetts General Hospital in 1846, and Professor of Surgery at Harvard in 1849, he served with distinction until his retirement from the hospital in 1886. He was one of the best products of the French school—a brilliant, meteoric teacher, a profound and exhaustive writer, a bold operator. The story of his life is full of interest, but he is known to us today mainly for his explanation of hip-joint dislocations—he named the Y-ligament—and for his elaboration of litholapaxy.

Besides these more conspicuous exponents of American surgery, there were appearing here and there men who performed deeds, sporadic deeds, many of them, of which the student of our history should read. **Bobbs,** of Indianapolis, devised the operation which is known to us today as cholecystostomy. He operated first in 1867, thirty-nine years ago, and removed fifty gall-stones. The next year, 1868, **J. Marion Sims** (1813–83), of New York, operated in the same way and removed sixty stones from the gall-bladder. He also introduced the silver wire suture in operating for vesico-vaginal fistula, and was one of the pioneer gynecologists of America. In 1850 **Morrill Wyman** and **Henry I. Bowditch** performed the operation of paracentesis thoracis, a great improvement over the familiar old proceeding of Hippocrates. Glancing back nearly to the beginning of the century, we read of **Brashear,** the pioneer Kentucky surgeon, who first in this country successfully performed primary amputation at the hip-joint, a feat which was not repeated until Mott's operation in 1824. **Gurdon Buck,** of New York, followed Parker in operating for appendicitis; he devised his well-known apparatus also for thigh fractures, in 1851, and excised the olecranon in 1842; while **Carnochan,** in 1856, excised the second branch of the fifth cranial nerve beyond Meckel's ganglion, for the relief of tic, and in 1853 excised the whole of the ulna.

John L. Atlee (1799–1885) and his brother, **Washington L. Atlee** (1808–78), of Pennsylvania, **Dunlap, Peaslee, Kimball, J. Marion Sims,** and **John Homans** advanced and placed upon a sound basis the operation of ovariotomy.

Such are some of the prominent names which strike one in reviewing the American surgical literature of the middle of the century. The Civil War followed, when the services of these men and their ingenuity were turned to the succor and relief of those wounded in battle. Though the mortality was high, according to modern standards, the record is a brilliant one, and the immense literature of the medical and surgical history of the Civil War deserves careful study.

The last era with which we have to deal is the present era, and is concerned largely with living men. I have called it the German-American

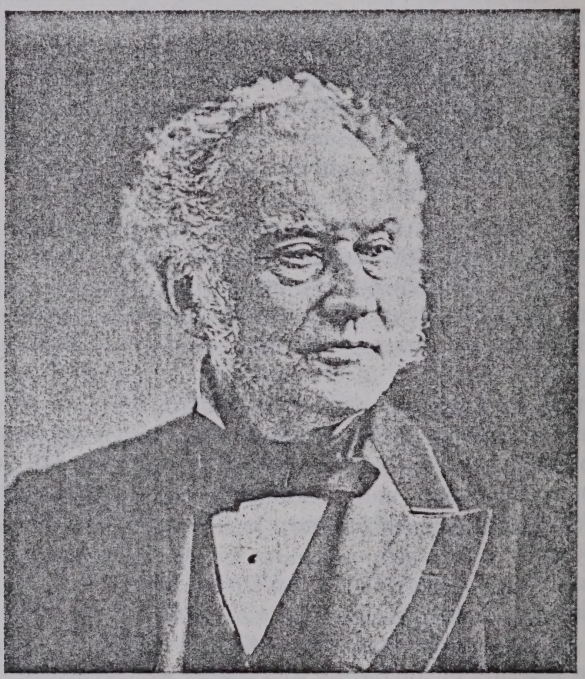

FIG. 8.—SAMUEL D. GROSS.

era, because it has been influenced enormously by the teachings of the German schools, whither the students of this generation have flocked in multitudes; but it depends also upon American accomplishments and upon work perfected in our own country by men whose initial training was largely German. One conspicuous man, in his day one of the most widely known surgeons in America, was **Samuel D. Gross** (1805–84). He belongs to the border-land between the French and the German-American eras. His work for surgical progress was so important, so far-reaching, and so thorough that he merits more than the brief mention we can give him here. Gross was a graduate of the Jefferson Medical College, and began his teaching life in Cincinnati and Louisville, after which he went to New York, and finally was called to the chair of surgery in the Jefferson

School, in 1865, which he held until he retired in 1882. He was a great teacher, a voluminous writer, and a man of the widest acquaintance. He and Bigelow caused American surgery to be respected in Europe, and he had the unique honor of being a laureate of Oxford, Cambridge, and Edinburgh. First of American authorities, he wrote a systematic treatise on pathologic anatomy. He was a publicist with many interests. He was a medical historian. Among his objects of special surgical importance was the investigation of abdominal stab wounds, the excision of the trifacial and spinal accessory nerves, the perfection of a urethrotome, and the study and treatment of tumors.

Samuel D. Gross is one of our few great surgeons who has been suitably honored by posterity. In 1897 the American Surgical Association, with the coöperation of the Alumni of Jefferson Medical College, erected in the city of Washington, to his memory, a handsome statue which stands in front of the Army Medical Museum.*

With this brief statement of what Americans have been doing, let us bring to a close, at the beginning of the present era, the story of their achievements. The present era is that which we properly call the era of modern surgery. It began with the introduction of antiseptic methods, and it has nourished and developed some of the greatest men in our surgical history. Many of these men are now living, their work not yet completed. They have contributed enormously to the advancement of our art in many fields. American accomplishment in abdominal surgery, in neurologic surgery, in genito-urinary surgery, in gynecology, and in the treatment of the eye, the ear, the throat, and the lungs, needs no apology. It stands for the best work being done in the world. Let us pass on to a consideration of the famous Englishman to whom our era owes the most, Joseph Lister.

JOSEPH LISTER.

BORN 1827.

The nineteenth century is immediately behind us. That is a phenomenon we are not likely to forget if the writers shall have their way. Six years ago we began the present century by celebrating the achievements of the last century, and, truly, the more we inspect those hundred years of progress, the more remarkable they appear. The advances in surgery have been marvelous; to the superficial observer they appear miraculous. In 1894 Billings wrote:† "More progress in the art has been made since 1800 than had been made in the two thousand years preceding that date." In 1904 Dennis said: "Surgery as a science made no profound impression upon the world until about a century ago." Such statements are specious, and are true in a special sense only. The achievements of the last century are wonderful indeed, but I have written these pages to little purpose if I have failed to show that the foundations of our art as well as of our science were laid deep long before the beginning

* "Trans. Amer. Surg. Assoc." 1897.
† Dennis's "System of Surgery," i, p. 91.

of the nineteenth century. Galen is a man to be reckoned with, and Vesalius, Paré, Harvey, and Malpighi, to say nothing of Haller and the Hunters. Such men were needed for the development of Cooper, Physick, Brodie, Warren, Syme, Paget, Dupuytren, Nélaton, Velpeau, Bigelow, von Graefe, von Langenbeck, Billroth, and Lister. The great and permanent achievement in surgery of the nineteenth century was the wide development and establishment of scientific methods of study. Out of those methods have come the marvels which we boast. Without them

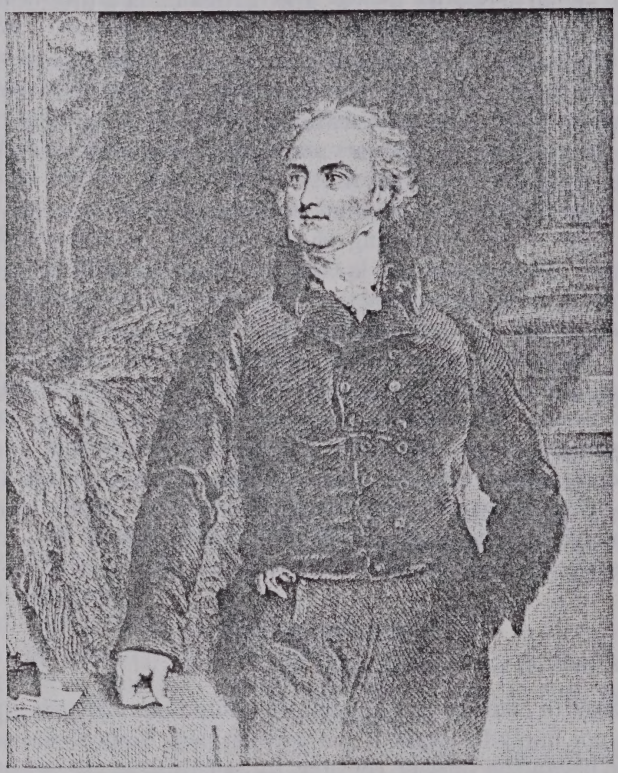

FIG. 9.—SIR ASTLEY PASTON COOPER, BART.

Morton would not have discovered anesthesia, nor Lister antisepsis; and Humphrey Davy, Jackson, and Pasteur were necessary to Morton and to Lister. History shall determine all this and shall correct our present perspectives.

All men, today, will agree that Joseph Lister is the commanding figure in the surgery of the nineteenth century; and I shall attempt, in the few pages that are left, to tell something of that great man, to place him in his proper setting and to sum up his achievement. He is still living, but, if he should chance to read these lines, he needs not this evidence that nowhere more than in America is his name revered and his teaching followed.

Thirty-four years elapsed between the death of John Hunter and the birth of Joseph Lister—a brief interval as science reckons time; while between the date of Hunter's last publication and the time of Lister's first studies in the antiseptic treatment of wounds there was an interval of nearly seventy years. It is worth our while to inquire somewhat into the doings of the surgical world during those seventy years. Names attract us first, and there are great names. In Great Britain and in our own America Hunter's pupils and their pupils carried on his work. During the first quarter of the last century London and Edinburgh were the resorts of students from all countries. There was the brilliant **Astley Cooper** (1768–1841), whose charm of manner, wide learning, phenomenal skill, and enthusiasm for his profession made him the most popular teacher of his time; **John Abernethy** (1764–1831), Cooper's colleague and rival, thought by many to be more deeply imbued with Hunter's teachings than any of his contemporaries, an able successor and exponent of his master. There also were Cline, Blizard, Home, Lawrence, and Wardrop in the same group. All were sound investigators, teachers, and writers. **Benjamin Collins Brodie** (1783–1862) belonged to a somewhat younger generation. He was a brilliant anatomist and operator, but was noted chiefly as an exhaustless physiologist and a delightful writer. Then there were **Charles Bell** (1778–1842), of Edinburgh and London, whose fame rests mainly on his discovery of the functions of the two roots of the spinal nerves, and his researches into the anatomy of the brain and of expression; Philip Syng Physick (1768–1837), of Philadelphia, a favorite pupil of Hunter, and his prophet in America; and John Collins Warren (1778–1856), of Boston, the first surgeon publicly to employ ether anesthesia (1846). Coming down further into the century, there were **Robert Liston** (1794-1847), of Edinburgh and London, famous for his strength, daring, and weird feats in the amphitheatre; **James Syme** (1799–1870), a renowned teacher in Edinburgh, a copious writer on excision of joints, amputations, and surgical pathology, and author of a text-book of surgery. He was Lister's father-in-law and the surgeon in "Rab and His Friends." **Abraham Colles** (1773–1843), of Dublin, was the first to describe that fracture of the radius which goes by his name; **Fergusson** (1808–77) was for many years the leading operator in London; **Erichsen** (1818–90) was the author of one of the best-known text-books which educated thousands of English and American students; while **James Y. Simpson** (1811–1870) aided to make the Edinburgh school renowned by his researches in the domain of both surgery and obstetrics. He is best known to us for his introduction of chloroform as an anesthetic in 1847. **Sir James Paget,** through his "Lectures on Surgical Pathology" (1853), gave a new impetus to scientific studies left unfinished by John Hunter. Those are a few of the men who made famous Scotch and English surgery. They developed hospitals, reorganized schools, and worked out a masterly technic of the old style. With their limited means, they set a pace which the present generation may regard with profound admiration.

Meantime, on the Continent, new men rose to fame, new schools were established, new centers were developed, and great reputations were

achieved. The political conditions which grew out of and succeeded the French Revolution produced strange combinations and brought to the front vigorous and fresh blood, which otherwise might have languished. The wars produced a great line of army surgeons; the problems of transportation, of field and hospital service, of operative measures, the combating of surgical infections, and the after-treatment of the wounded continually exercised ingenious minds. With enlarged political conditions native talent found encouragement, and monarchs came to see that genius of all sorts must be encouraged if nations are to compete successfully with their rivals. So one finds Napoleon drafting young men into his schools of military surgery, securing for them distinguished instructors, introducing rational anatomy laws, encouraging competition, and fostering science. Vienna, Berlin, and other capitals followed the lead of Paris; medical schools and their associated hospitals became part of the government system; medical education and the license to practise were made matters of vital concern to the State; great research laboratories were instituted, museums and libraries were collected, and facilities such as the world had never yet seen for medical education were provided and made imperative.

Great surgeons grew up under such a system, and their works were commensurate with their pains. At a few such men let us glance. The Paris school and hospitals were the most famous in the second quarter of the nineteenth century. The school, fostered by government, was definitely organized in 1804; in 1806 the Imperial University was created, and in 1808 the medical school became its faculty of medicine. **Dominique Jean Larrey** (1766–1842) was Napoleon's great army surgeon. You shall read with delight his "Memoirs of Military Medicine," a mine of information. He appreciated the value of surgical rest, and relates scores of remarkable and instructive cases. He lived for years as the beloved Nestor of the profession. **Guillaume Dupuytren** (1778–1835) was surgeon-in-chief to the Hôtel Dieu, from 1815. He was a bold, self-reliant, stern, unpopular man, a physiologist and pathologist, and for years a great power in the world of surgery. **Jacques Lisfranc** (1790–1847) is famous for his amputation of the foot; he was a past-master in all sorts of amputations and was known also for his excisions of the jaw, the rectum, and the cervix uteri. **Jean Civiale** (1792–1867) made his mark as a great genito-urinary surgeon. **Alfred Armand Louis Marie Velpeau** (1795–1867), surgeon to La Pitié and professor of clinical surgery in the faculty, after 1833, was a strong, resourceful, and useful man, a thorough anatomist and an able operator. He was a great worker and a splendid teacher—perhaps the most valuable surgical member of the French school in the first half of the last century.

Joseph Francois Malgaigne (1806–1865) is the greatest surgical critic and historian known to us. As a speaker and publicist he will endure, but his work as a practical surgeon is ephemeral. **Auguste Nélaton** (1807–1873) is thought by many to be the best surgeon who has yet appeared in France—diagnostician, operator, teacher. He published "Elements of Surgical Pathology" in five volumes.

So much for a few of that famous French school upon which one fain

would linger. It is hard to pass by such names, but so, too, with a few Italians and many Germans. There was the great surgeon and anatomist, **Antonius Scarpa** (1752–1832), of Modena and Padua—he of Scarpa's triangle; **Vincenz Sebastian von Kern** (1760–1829), the great Viennese surgeon from 1805 to 1824; and **Philip Franz von Walther** (1782–1849), professor of surgery at Munich after 1830, the founder of modern surgery in Bavaria. **Carl Ferdinand von Graefe** (1787–1840) from 1810 was the distinguished first professor of surgery at the newly established University of Berlin. **Johann Friedrich Dieffenbach** (1792–1847) succeeded von Graefe at Berlin in 1840; a great and ingenious operating surgeon, he is known to us especially as the originator of the operation of tenotomy for

FIG. 10.—BERNHARD R. K. VON LANGENBECK.

strabismus. **Maxmilian Joseph von Chelius** (1794–1876) wrote a delightful and valuable "Handbook of Surgery," which had a wide influence. He was professor of surgery at Heidelberg.

The most eminent German surgeon of the last century was **Bernhard Rudolph Konrad von Langenbeck** (1810–1887), the Astley Cooper of Germany. von Langenbeck succeeded Dieffenbach in the chair of surgery at Berlin in 1847, and for forty years was a power in the land. He devised numerous operations, made countless improvements in technic, and established two important journals of surgery; but, as Billings says, his greatest contribution to surgery has been his pupils. Passing over Zeis, Stilling, Heine, Loeffler, Lücke, Hueter, Maas, Vogt, Volkmann, we must

recall especially **Theodor Billroth** (1829–1894), the famous professor of Vienna after 1867. He was a pupil of von Langenbeck and was almost equally remarkable. A many-sided man, interested in and concerned with every new thing, he was a daring and original operator and an inspiring teacher. He excised the larynx in 1873 and the stomach in 1881. Dozens of American surgeons, now active, studied under him, and his name is a household word among us.

FIG. 11.—DR. THEODOR BILLROTH.

We have seen that the two great surgical events of the last century were the discovery of anesthesia and the development of antisepsis. In a measure the two go together. Either would be less effective lacking the other. Lister was a student in University College, London, when ether anesthesia was demonstrated in Boston; and though he had not yet begun his medical studies, the fame of the discovery, if not the enthusiasm for it of Liston, who, first of English surgeons, used ether in the North London Hospital, must have stirred Lister's youthful mind.

Joseph Lister was born on April 5, 1827, at Upton, in Essex County, England. He is not a Scotchman, as many think, though his notable work was done in Scotch universities. His biography has not yet been

published, so that material for a sketch of Lister's career is scanty and scattered. Four years ago (1902) there was the Lister jubilee, to commemorate his fifty years of professional life. English medical journals celebrated the event in articles furnished by some of his old friends and pupils. From such sources and from the writings of the man himself one may construct a broken story. As the "British Medical Journal" says,

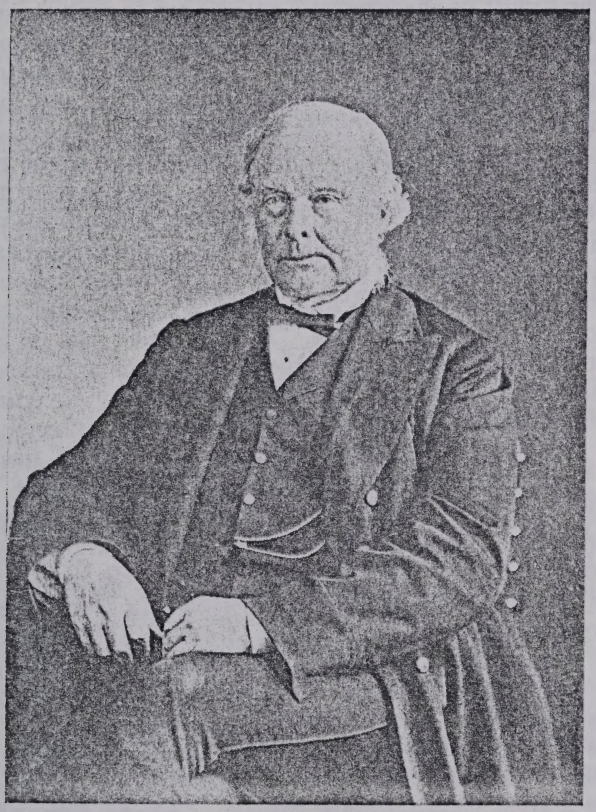

FIG. 12.—LORD LISTER, O.M., F.R.S., F.R.C.S.

its contributors "have related the biography of a scientific thesis rather than of the man who established it."

Lister's father was Joseph Jackson Lister and his mother was Isabella, daughter of Anthony Harris, of Maryport, Cumberland. The elder Listers were Quakers. The mother died in 1864 and the father in 1869. Joseph Jackson Lister, following his own father's trade, was a wine merchant in London, but in spite of the claims of business, he was through life an earnest student of science. He made important improvements in the microscope, and in the year that saw the birth of his distinguished son, he published, with Thomas Hodgkin, a paper entitled "Some Microscopical Observations of the Blood and Animal Tissues." His son wrote a life

of him for the "Dictionary of National Biography," from which it appears that the senior Lister was a useful and constant contributor to the construction of the microscope and to microscopic studies. In 1834 he became a Fellow of the Royal Society.

Joseph Lister was carefully educated for his profession. He went to a private school, as a lad, and then to University College, whence he was graduated B. A. in 1847. In that same year, at the age of twenty, he began the study of medicine, which he followed zealously for five years in the Medical Faculty of University College and at University College Hospital. During this course he was greatly influenced by Graham, professor of chemistry, and Sharpey, professor of physiology—strong and inspiring men. His father's influence with him was important, too, in those years, so that we hear of the young man's devoting himself early to histologic research. His first published paper, written in 1852, dealt with the existence in the iris of tissue identical with ordinary unstriped muscle, and with its distribution. In 1853 he produced "Observations on the Muscular Tissue of the Skin." Meantime, in 1852, he had been graduated M. B., and had become a member of the Royal College of Surgeons. In the hospital Lister served as dresser and house-surgeon to J. E. Erichsen; his own house-surgeon and senior while he was in the former office being Henry Thompson. Of those early years we know little as yet, though we must believe they were fruitful years; for what years of Lister's busy life have failed of accomplishment?

On leaving the hospital he followed the advice of Sharpey and Thompson, and went to Edinburgh. Sharpey told him to take six weeks of Syme's clinic. Now, Syme had gone up to London to be a surgeon to the University College Hospital in 1848, for a few months after Liston's death. So Lister went to Scotland for six weeks, and in Scotland he worked and taught for twenty-three years. He went to Scotland an obscure student; he returned to England one of the lights of the surgical world.

One may divide geographically the progress of Lister's career: A youthful period in Edinburgh, from 1854 to 1860; Professor of Surgery in Glasgow, from 1860 to 1869; Professor of Clinical Surgery in Edinburgh, from 1869 to 1877; Professor of Clinical Surgery in King's College, London, from 1877 to 1893, when at the age of sixty-six he retired from active teaching and was made Emeritus Professor of Clinical Surgery and Consulting Surgeon to the Hospital.

At the time of Lister's going to Edinburgh the frightful mortality of troops in the Crimean War was exercising men. Soldiers were being killed in battle by tens and hundreds, but they were dying of surgical diseases by thousands. The newly aroused science of Europe was keenly aware of these facts, and in the great hospitals surgeons groped after causes and remedies, fruitlessly for the most part. Indeed, a sort of fatalism appeared to be settling upon the profession. That hopeless view seems never to have subdued Lister. Sir Hector C. Cameron writes that "the grief and mental worry arising from such experiences, often repeated, produced in Lister's mind a sense of discontent with things as they were, and this seemed to many of us who were his pupils in strange contrast to

the resignation with which some of his colleagues viewed similar experiences."

One cannot say just when it was that Lister began constantly turning his mind to the problem of a remedy for wound infection. Perhaps he himself could not tell us now, but he must have been dwelling upon such things very early in his career. We may conceive of the condition in those old hospitals, and of wounds in general, from the descriptions in the books and from the tales of men whose professional memories go back thirty-five years or more. In the hospitals surgical sepsis ran rampant. Secondary hemorrhage, erysipelas, septicemia, pyemia, and "hospital gangrene" were endemic. Sometimes wards, wings, or whole institutions were closed, in vain attempts to stamp out these disorders. Operations in private houses, especially in the country, were less dangerous than in hospitals, but even in private practice the mortality from sepsis was high. Sometimes a surgeon would wear the same old operating coat for years, and would pick waxed ligatures from the button-hole of his assistant, who carried them there for the convenience of his chief. Old hands will tell you such stories by the score. To the modern surgeon it is a barbarous era.

In Edinburgh Lister acted for a time as resident surgeon to Syme at the Royal Infirmary, and in 1856 became assistant surgeon to the same distinguished man. Syme was a brilliant and resourceful operator, and the admiration and affection between the two men was constant and abiding. Lister married Syme's daughter. Annandale tells how in the early days Syme often spoke to him of his appreciation of and pride in Lister's original scientific spirit and work, and his belief that such work would result in an important advancement of surgical practice. So far as one may judge, Lister has won through life golden opinions from those with whom he has come in contact. In his early days his colleagues admired him and his pupils accepted him with whole-hearted enthusiasm, even while the outside world heard him with a shrug or opposed him with vigorous incredulity. Lister's temperament and method were very different from those of John Hunter. He was never contemptuous, loud, or bellicose, but out of thorough study and careful observation drew conclusions which he put persuasively and persistently before the surgical world. The surgical world was forced reluctantly to accept them.

While in Edinburgh, besides assisting Syme, Lister gave admirable courses of systematic lectures on surgery, and carried out numerous original investigations, notably on the coagulation of the blood. One must remember that he is a practical surgeon as well as a laboratory student; in his active days he was an ingenious and able operator, as became the pupil of Syme, and for the greater part of his life he has been a professor of clinical surgery. He remained in Edinburgh in this early time until 1860, his thirty-fourth year, and it was during the last of this period that he began his bacteriologic studies in connection with antiseptic surgery. With an eye single to this great problem he kept a lookout for what the rest of the world was doing, and it was now that the significant researches of Pasteur attracted him. It is well for us, too, to take note of the great Frenchman and of his service to surgery.

Louis Pasteur was five years Lister's senior. The son of an old Peninsular veteran, he was well educated for a scientific career, and was a pupil of Dumas, the famous chemist.* The story of his studies in fermentation and spontaneous generation is a classic of scientific literature. By 1860 he had convinced himself of the importance of the rôle played by microbes in the production of fermentation, as opposed to the old view of Liebig, that it is a "change in organic fluids and tissues set in motion by the access of oxygen or of bodies in a state of decomposition." After the demonstration of the cause of fermentation, there followed experiments and discussions on spontaneous generation and the establishment of Pasteur's thesis of the non-existence of such generation.

These two great facts being admitted, what was their bearing upon putrefaction and wound infection? Vallery-Radot tells an anecdote of Pasteur's interview with Napoleon III in 1863, when the Emperor questioned Pasteur closely on his studies and conclusions. The next day Pasteur wrote: "I assured the Emperor that all my ambition was to arrive at the knowledge of the causes of putrid and contagious diseases."

This is not a history of bacteriology, but we are dangerously near that fascinating topic. Suffice it to say that in Scotland Lister's growing belief in an external agent as the cause of wound infections was strengthened and confirmed by Pasteur's researches, for in 1867 he was able to write: "Turning now to the question how the atmosphere produces decomposition of organic substances, we find that a flood of light has been thrown upon this most important subject by the philosophic researches of M. Pasteur, who has demonstrated by thoroughly convincing evidence that it is not to its oxygen or to any of its gaseous constituents that the air owes this property, but to minute particles suspended in it."

In 1860 Lister had achieved so enviable a reputation in Edinburgh as a brilliant and sound teacher and judicious operating surgeon that he was called to the professorship of surgery in the University of Glasgow. The next year he was made a surgeon to the Royal Infirmary there. In both offices he met with gratifying success, and, as one would expect, he continued to devote himself, in this broader field, to the problem of antiseptics. He believed then and for many years afterward that the air was the vehicle which brought poison to wounds, though he recognized then and with increasing perception as the years passed that all foreign substances—clothing, skin, instruments, sponges, ligatures—were also contagion-carriers. Even before finding a satisfactory antiseptic he insisted that operators and dressers should be scrupulously clean, and he employed sundry deodorant lotions about wounds. He had not then concluded that putrefaction and suppuration are distinct processes and are due to distinct causes. He regarded wound-infection as putrefaction; and what wonder, considering that putrefaction did frequently occur and simulated inflammations of the most virulent type? The science of bacteriology was in its infancy, and no one appreciated the different forms of organisms,

* Read Vallery-Radot's "Life of Pasteur," one of the most delightful and stimulating of biographies.

much less the distinction between pathogenic, pyogenic, and saprophytic bacteria.

Whatever the active and offending agents might be, Pasteur's teaching confirmed Lister's opinion that they were omnipresent, and he sought an antidote. So he was led to his famous carbolic acid,* an agent little known then in Great Britain. He had been impressed by the action of carbolic acid employed in disinfecting the sewage of the town of Carlisle, where it had deodorized pastures and destroyed parasites which were said to infect cattle.

At that time Lister's ingenuity was exercised especially to save cases of compound fracture, in which the mortality had always been great, and it was in such cases, in 1864, that he proposed to use his new remedy. He recognized that the most severely lacerating *simple* fractures healed without special disturbance, and convinced as he was that it was the air admitted to *compound* fractures which rendered them dangerous, he sought to reduce them to the *simple* state by excluding air, or by opposing to the air a barrier which should render harmless its offending germs. Accordingly he wiped out the wound with pure carbolic acid and then sealed it with lint soaked in carbolic. The exudations, mingling with the acid, formed a paste which soon hardened into a firm scab. In order to prevent too rapid evaporation of the agent he laid over this dressing a block-tin shield. So long as active inflammation did not appear, the carbolic scab was painted daily with more carbolic to keep in force a fresh supply of the germicide, and the shield was reapplied daily. The surprising success of this treatment in the case of compound fractures led to its employment in abscesses and in fresh wounds. Sometimes it was impossible to secure exudate of proper quality to mix with the carbolic for a paste, so an artificial paste of linseed oil, carbonate of lime, and carbolic acid was devised. This was Lister's famous "antiseptic putty."

In such fashion the work progressed during those nine Glasgow years. The antiseptic principle was gradually extended to all varieties of surgical lesions, to septic processes, to fresh accidental wounds, and to operation wounds—amputations, excisions, and their like. As yet the treatment was crude, and consisted merely in modifying and extending the carbolic acid applications. Says Cameron: "It only remains to be added that the effects of the new treatment upon the wards were in the highest degree beneficial, converting them from some of the most unhealthy in the kingdom into models of healthiness."

Syme retired from the chair of clinical surgery at Edinburgh in 1869, and Lister was called from Glasgow to take the vacant place. By this time the new treatment had been well advertised through the lectures, papers, and addresses of its author, and the world was beginning to listen, but with an indulgent smile. As Chiene says: "Lister devoted his introductory (Edinburgh) lecture to 'an endeavor to convince' his hearers of 'the truth of the germ theory of putrefaction,' 'the basis of a new method

* Küchenmeister, of Dresden, had reported good results from carbolic acid in 1860, and Lemaire's work on carbolic acid (which was then known as "acide phénique") was published in 1865.

of treatment,' 'the antiseptic system.' "* These views were new to most of his listeners, and were heard with many questionings, but he continued to expound, to practise, and to demonstrate so effectively that when he left Edinburgh, eight years later, his theories had been received there and his precepts were followed in some fashion.

Lister's second residence in Edinburgh marks a service of continued development. Pasteur and himself, as well as other students, were advancing along lines which meant a constant expansion of bacteriology and the intelligent application of its principles to the problem of sepsis and wound healing. The Franco-Prussian war of 1870 had its lessons for French and German surgeons; scourges raged through the armies, though such men as Volkmann, von Esmarch, and others were beginning to employ simplified measures and a more rational therapeutics. The voice of Lister was finding its echo even on the battle-field. At home the modest great man was gaining strength continually. A writer in the "British Medical Journal" tells of the feeling akin to awe with which the younger medical generation of those days saw Lister, in defiance of tradition and authority, but secure in the certainty of scientific truth, do many things which at that time were condemned by professional opinion as most dangerous procedures.†

In 1877 Lister made his final move to London, where he was called to the chair of clinical surgery in King's College. He went reluctantly, for he was fifty years old and had long been doing congenial tasks among friends; but the new field was wide, the audience great, and the urging strong.

We may not follow the detail of his subsequent career or the growth of his work. Suffice it that time brought important modifications in his practice but not in his theory. Particular antiseptics came and went, the carbolic spray was used and was banished. Air was found to be not a dreaded enemy and carrier of disease, but a kindly friend when properly entreated; surgical cleanliness, a germ-free environment, became recognized as the one thing needed. Heat, soap and water, the nail-brush, alcohol, and a few simple chemicals took their place in our armamentarium, and *asepsis* supplanted *antisepsis*. But the great underlying truth remained: that wound-infection comes from without the wound, that it flourishes under appropriate conditions, that it may be eliminated by appropriate measures.

Twenty-five years ago Lister had won his victory, and saw his principles adopted throughout the surgical world. Who may tell the effect of that victory on surgical progress? No man has reckoned the immeasurable saving of life, the incomputable relief of suffering, the opening of new surgical fields. Daring has become conservatism; rashness has become common sense. The cranial cavity, the thorax, the abdomen, the lungs, the heart, the intestines, joints, the ear, the eye, regions and organs which were once sacred to the action of disease, which were inspected on the

* In his Liverpool address before the British Association, 1896, Lister told simply the story of modern surgery and of his part in it.

† "Brit. Medical Journal," vol. for 1902, p. 1856.

post-mortem table only, are now opened freely to the renovating measures of the surgeon and to the gaze of every medical student.

Eloquent volumes have been written to celebrate these great themes; this feeble pen can but trace its eulogy in humble echo.

Lister, the man and scientist, has been rewarded in a manner, so far as our human rewards may express gratitude. The list of his honors and degrees would fill more than one of these pages. He is a member of all sorts of learned bodies at home and abroad; Oxford, Edinburgh, Dublin, Glasgow, Cambridge, Toronto, have loaded him with their highest diplomas; portraits of him hang in distinguished halls where they fix the eyes of the world's great ones; he has presided over august assemblies; Queen Victoria made him a baronet in 1883, and in 1897 he was raised to the peerage, with the title Baron Lister—the first and only representative of the medical profession to be so honored in Great Britain.

How shall one sum up and estimate what he represents? Writers are wont to describe surgeons as great for their knowledge, their multitude of patients, their writing of books, their popularity as teachers. A lower estimate is to count him the great surgeon who is a great handicraftsman. But who shall be numbered with the immortals? We know that mere mechanical facility in surgery is not enough. It is permanent contribution to knowledge which counts. The uninformed look to closet students for such contributions, but have we not seen great operators who were great contributors? Mere operators are not known to history. Even the typical clinical surgeon, Paré, is memorable to most men for his invention of the ligature only. In our own time and in America the question of the appendix has agitated men. Surgeons have reported their hundreds of appendectomies amid the winding of horns and screams from the gallery gods, but the prize lies with that modest scientist* who, twenty years ago, gave to the world a single paper, in which he described the significance of the appendix and its rôle in disease. Last year only was he rewarded with the LL.D. by his alma mater.

And so with Lister; thoroughly educated to use the tools of his trade, profoundly versed in the science of his time, he spent his youth in acquiring and perfecting himself in what the world already knew of surgery. In his prime a skilful operator because operating was part of his business, an accomplished clinician because clinical surgery was his forte, he appreciated that the greatest work in science is creative work. His genius grasped at a breathless possibility, never before conceived by conservative minds; and so, following those sound inductive methods known to science through the ages, he launched us upon an era which is truly the most brilliant in the history of surgery.

* Reginald Heber Fitz.

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Most of the portraits in this chapter were kindly furnished by the Library of the College of Physicians of Philadelphia; that of Warren by his son, Dr. J. Collins Warren; that of Gross by his son, A. Haller Gross, Esq.; and that of Lord Lister by himself, through J. Bland-Sutton, Esq.

CHAPTER II.

SURGICAL PHYSIOLOGY.

By George W. Crile, M.D.,

Cleveland, Ohio.

In the limited space set apart for this subject but few of the topics deserving attention will be considered, and these only in brief.

Definition.—The scope and the application of surgical physiology are similar to those of surgical anatomy and surgical pathology. It embraces such laws and factors as are used in surgical practice, which rest largely upon altered physiologic actions. There is scarcely a diagnosis made or an operation performed that does not draw heavily upon our store of physiologic knowledge.

SURGICAL PHYSIOLOGY OF THE CIRCULATION.

Heart.—As a muscle the heart is probably the most highly organized and performs the most important function of the various muscles—striped, non-striped, and mixed—of the body. It has a wider range of compensation and certain other characteristics and limitations that are of great importance surgically. In its response to trauma of various kinds it shows marked individuality. A stab or gunshot wound in one instance may cause only temporary alteration of function, while in another immediate death may result. Direct manipulation of the heart in one instance may have but slight effect, in others inhibition and irregularity at once appear. The so-called short-rib or solar plexus blow may cause instant death by mechanical inhibition of the heart (Fig. 13). Experimental research has definitely proved that the collapse or death thus caused is in no way connected with the solar plexus, the diaphragm, or the splanchnic nerves. From a therapeutic standpoint, no drug has as yet been found that will protect the heart against the important alterations as a result of mechanical manipulation or trauma. Neither are these phenomena modified by anesthetics. In operations upon and about the heart, then, prevention is the best treatment.

Physiologic research and clinical experience have shown that when the heart-muscle is damaged or its nutrition impaired by acute infection, by anemia, by arteriosclerosis or advanced age, by valvular lesions, by fatty degeneration or by overwork, as occurs in athletics, it is more susceptible to trauma and mechanical interference than is the normal organ. One would hesitate much more to perform an operation on a senile heart than upon that of a young adult.

Acute dilatation and *paralysis of the heart* is a phase of surgical physiology that demands special attention. It is established that the output

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